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MECHANICAL EDITION

INCLUDING THE

AMERICAN ENGINEER

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CONTENTS

Master Blacksmiths' Convention

The convention of the International Railroad Master Blacksmiths' Association, held in Milwaukee last month, was attended by a large proportion of the membership of the association. Those who registered attended all sessions, both morning and afternoon, in goodly numbers. The program included reports on fourteen subjects, which, in the time allotted, could not help but seriously limit the discussion. The association is apparently trying to fully cover its field at every convention. The wisdom of this, especially when no advance papers are published, may be questioned. It would seem better to restrict the subjects to those that are calling for the greatest attention at this time. By doing this the members would come to the convention better prepared for the discussion of the different reports. Some of the less important subjects could be taken up every other year, or every three years. The suggestion of Mr. Carruthers that the number of members of the committees be decreased in order that the committee members may have greater responsibility is a good one, and it is believed, will produce better results.

Inspection at Engine Houses

Most of the articles received in the recent competition on engine house work laid stress on the value of a thorough inspection of locomotives when they arrive at engine houses. There was a time when locomotives were considerably smaller than they are today and working conditions were different, when every engineman took a direct interest in the locomotive which he was operating and could be depended on not only to make a thorough inspection and report all the work necessary, but to personally attend to small defects. Undoubtedly the pooling of engines has had a great deal to do with the falling off in this interest on the part of enginemen and while it is decidedly rare to come across a man who cannot find enough work to report to fill considerable space in the work book, it by no means follows that the locomotive has been thoroughly inspected. It is doubtful whether it is advisable to relieve the enginemen entirely of the responsibility of inspection; considerable success has been reported in some cases where the practice is employed of making the shop inspector go over the entire locomotive and furnish an independent report. The practice varies to quite an extent, but there can be no doubt that a thorough inspection at the engine house by an inspector who is a trained mechanic will help greatly in the finding of small defects and remedying them before they become large ones and run up the cost of repairs.

The Draft Gear Problem

In this number appears the last of the series of contributions which were accepted for publication as a result of the draft gear competition. They all favor the friction draft gear, as did two out of twelve of the papers which were recommended by the judges for publication. In still another part of the paper will be found an interesting and forceful communication favoring the spring gear as compared with the friction draft gear. It presents an entirely new viewpoint and rounds out the discussion as far as it has thus far progressed. We hope for, and in fact we shall be greatly disappointed if we do not receive many other communications on this most important problem now that the articles presented in the competition have been placed on record. What points have you noticed that have not been covered? What data have you that will help to clear up the problem? We want it—our readers need it! One thing is apparent. The Master Car Builders' Association has a big opportunity before it if it will promptly and effectively investigate and report on this problem. Railroad clubs and other similar organizations should actively come to the front in agitating and discussing it. The American Rail-

way Association will be remiss in its duty if it does not order an investigation and report on abuses to equipment by the operating department, and at the same time insist on an immediate and thorough investigation of the draft gear problem by mechanical department officers. Theory and guess work should be relegated to the background and hard, cold, practical facts should settle the problem once and for all. If they are not available, and apparently they are not to any very great extent, then those in authority should set the machinery in motion to develop them, for surely the problem is not insurmountable if properly handled.

Car Department Competition

The series of articles on defective box cars and damaged freight which appeared in the Railway Age Gazette about two years ago attracted considerable attention and since that time there has been quite an advance made in the design, construction and maintenance of box cars along the lines of providing greater protection for the lading. There remains a great deal to be done, however, and with a view to developing a better understanding of the defects of box cars and the remedies which should be applied, we announced in the August issue, page 395, a competition to close October 15, 1914, on defective box cars and how the defects may be eliminated. Leaving the draft gear out of consideration, what, in your opinion, is the greatest defect in box cars and how can it best be remedied? A prize of $50 will be awarded for the best paper outlining what the writer considers the most important defect and providing suggestions as to how it may be overcome. The judges will base their decision on the practical value of the suggestions offered. Articles which are not awarded a prize, but which are accepted for publication will be paid for at our regular space rates.

Designing Locomotives to Suit Conditions

In discussing the distribution of power on page 278 of the June, 1914, issue, we stated that it should not be expected that all locomotives will work equally well under all conditions. A great deal can be accomplished toward economy by carefully studying the conditions obtaining on different parts of a railway and distributing the locomotives to the various divisions according to their suitability to the different conditions. Some roads have found it necessary to go to considerable trouble and expense in studying the assignment of power to the best advantage, a great deal of which could have been avoided by a careful study of conditions before ordering new locomotives and the working out of designs to cope with these conditions. It is by no means uncommon practice for a railroad to order a number of locomotives of one class and after they arrive to distribute them to different parts of the road with very little regard to their suitability to the work in that section, the only consideration being that there is a shortage of power there. It is because of such practices as this that locomotives with large driving wheels are, in quite a number of cases, being used on districts with heavy grades where locomotives with smaller wheels would do the work much more satisfactorily; on the other hand, it is poor practice to design locomotives to suit the heaviest operating conditions on a large road, such as heavy grade, short curvature and heavy trains and then employ exactly the same locomotives on districts running through a level country where there are few curves. Another poor practice is the ordering of a number of locomotives all equipped with one type of grate and then operating them on different parts of the road where the fuel conditions are dissimilar.

When such practices as these obtain, a railway is not getting the maximum possible number of ton-miles per ton of coal from its locomotives. Economy in fuel consumption is one of the greatest single problems that confronts the railways today. A few roads seem to be giving this problem the attention it deserves, but there remains much to be done. The matter of locomotive design has a direct and very considerable bearing on fuel economy and if, in ordering new locomotives, designs are selected to suit the conditions which are to be met and the engines then kept as nearly as possible on the service for which they were originally intended instead of being distributed indiscriminately over the entire system, a long step will have been made in the right direction in the campaign for fuel economy. Such an action may, it is true, require a greater number of designs to be employed, but there is no reason why the matter of interchangeability of such parts as it is desirable to standardize should be materially affected.

Vibratory Requirement for Staybolt Iron

It is well known that the physical characteristics of iron and steel, as determined by static tests, do not necessarily indicate that the metal may not fail after a relatively short period of service, under stresses well within the elastic limit. Several types of vibratory testing machines have been developed during the past few years in an effort to provide a test, the results of which will bear a direct relation to the ability of the metal to maintain its strength and ductility in service. A vibratory test would seem to be the logical means of determining this ability to resist fatigue, and it should be especially useful when applied to staybolt iron. So far, however, such tests have not been satisfactory. Specimens of iron taken from the same bar and tested in the same machine have shown results varying so widely that the reliability of comparisons between different irons based upon the results of similar tests is very much in doubt. This is probably due to lack of rigidity in the machines and to lack of sufficiently close uniformity in the test specimens. Developments, however, may be confidently expected which will overcome these difficulties.

The machines now in use vary widely in construction and methods of operation and the results are not comparable. This condition stands in the way of the general use of a vibratory requirement in specifications for staybolt iron, as was brought out at the recent meeting of the American Society for Testing Materials in the report of the committee on standard specifications for wrought iron. This committee, after a series of tests, found it impossible to formulate a standard method of testing which could be adhered to on any two types of machine; and a vibratory requirement will not be included in the standard specifications for staybolt iron until a machine of sufficient merit presents itself to warrant its choice as a basis on which to formulate a standard vibratory requirement. The inclusion of such a requirement in specifications for staybolt iron, in the present state of the art, does not seem justified either as a means of comparison between irons or as a basis upon which to accept or reject material.

Mechanical Department Records

It is a strange attitude that is assumed by some mechanical department officers toward any suggested increase in clerical work, such as the introduction of a new form for record-keeping purposes. They seem to cling tenaciously to the idea that there are too many records kept already and that any addition to them is worse than useless. It is true that there are many records kept of a nature that makes their value extremely doubtful; but it is very often the case that while those kept are of little use and the time employed in their preparation could be used to better advantage in some other way, there is time being lost elsewhere because of a lack of data which could be obtained readily if the proper records were available. Chief clerks should be in a good position to tell what records are necessary and what ones are not, and a very good test to place on each one

is the question, "Is it supplying necessary information; if so, is it supplying it in the best and most concise form?" Any record which will not stand this test should be discontinued. On the other hand, experience and necessity should dictate the starting of new records; a chief clerk who finds himself continually having to furnish information along lines not covered in existing records should be able to judge for himself whether or not it is desirable to keep a permanent record of such information, and if it is desirable, a new form should be started. The mechanical departments of many railways suffer more from a lack of information, due to insufficient records, than they do from too much record keeping. There are mechanical department officers who do not make improvements in their shops or in their organization, simply because they have nothing to show them where such changes are needed, a condition that would not exist if the proper records were kept. In this connection it is strange that the graphical method is not employed to a greater extent than it is; this means of keeping records is so extremely simple and gives desired information so much more plainly and quickly than do tabular forms that its use could be greatly extended to advantage.

A Word of Thanks

The popular conception of an editor seems to be that of a hard and tireless worker who sits in his sanctum with shirt sleeves rolled to the elbow and by many means of communication which center in his den feels the pulse of the field which he serves and prescribes the treatment which he considers will best meet the needs of the patient. This is all well enough as far as it goes, but the editor in the technical field today finds it necessary to go far beyond this. He must be on more or less intimate terms with the men on the firing line who are doing things and must spend a large part of his time outside of his office studying conditions first hand. His efforts are successful only insofar as he can enlist and hold the hearty co-operation of the men who are doing things. He is expected to do and say the right thing at the right time and to act as a pioneer or beacon light in pointing the way to better things. He does not expect applause or appreciation for this. He does not want it, except as it may indicate that he is "hitting the nail square on the head."

What he does want and what he greatly appreciates is frank and square-from-the-shoulder criticisms of things which are published in his journal, or additional data or facts to back up his conclusions. His whole heart and soul is set on bettering things in his particular field and indications of interest and helpfulness spur him on to greater efforts. If there is one thing that really makes him feel bad it is an expression such as the following when he visits a district from which he has been absent for some time: "You were away behind when you published that stuff about the Ureaka Railroad last year. We can beat it all hollow." How much better it would have been had the editor been advised concerning it when the question was a live issue. Two or three minutes and a two-cent stamp would have done this. Better still, a clear-cut, concise letter for publication would have done a considerable favor to both the readers and the editor.

It is with this in mind that we wish to extend hearty appreciation to those of our readers who have contributed sc freely and so well to the communications in this number. They are splendid. Please do not picture the editor as a dignified, cold-blooded machine, who is too big or too far away to be your confidant, or who does not need your help. He is just as human as you are and in the effort to keep in close touch with progress and to rightly judge the trend of events he needs the help of every reader; after all we are really one big association with one common interest and each one of us owes it to all the others to do our little part in making the mechanical department more effective and more efficient. Will *you* help the editor?

Limitations of the Designer

The engineman, after his first trip on the new locomotive, climbed down out of the cab with a satisfied smile on his face. "That is sure one fine engine," he said. Why? It was supposed to be a duplicate of the previous order and was built at the same works. Examination proved, however, that it differed in many minor respects in the arrangement of the apparatus in the cab and that the engineman had good cause for his commendation. The arrangement of the apparatus on the back head and of the various levers and valves which the engineman had to use were remarkable for the neatness of arrangement and convenience in handling. As the engineman put it: "Everything is exactly where it ought to be and it is just like falling off a log to handle her. We never had anything like it on this road." How did this improvement come about? Who was responsible? On the earlier order of locomotives the leading locomotive draftsman laid out the arrangement of this apparatus. He had never run a locomotive. He had seldom been on one, but he was a bright young fellow who had had a splendid shop experience after a good college training.

Who, then, was responsible for the cab arrangement on the new locomotives? The general road foreman of engines had visited the builders when the first cab was being fitted up and seating himself on the engineman's seat box had pointed out exactly where the levers and valves, gages, etc., should be placed. He knew nothing about design, but had spent his life running locomotives. As a result, old locomotives are now being changed as fast as conditions will permit and practice, not theory, will hereafter govern the arrangement of cabs on that particular road. It was because the mechanical engineer realized the limitations of his staff that the general road foreman had made the trip to the works. It was because this same mechanical engineer utilized the practical knowledge of operating department and car repair department officers that his office is credited with designing a particularly good box car from the standpoint of protection to the lading. One of the good signs of the times is the way such co-operation is being extended on most of our railroads. Truly it is a healthy sign when the designer awakens to a sense of his limitations.

NEW BOOKS

Traffic Glossary. By R. E. Riley, instructor in Interstate Commerce, La Salle Extension University, Chicago. 136 pages, 6 in. by 9 in. Bound in paper. Published by La Salle Extension University, Chicago, Ill. Price $1.

This book was prepared primarily for use in connection with the La Salle University courses, but it should be found of great use to any student of traffic matters in obtaining information as to the terms in general use. The book is divided into four sections, one giving definitions of traffic territory, the second containing definitions of traffic terms and abbreviations, the third treating of the application of classifications and the last containing test questions.

Air Brake Catechism. By Robert H. Blackall. 406 pages, 4½ in. by 6½ in., 149 illustrations. Bound in cloth. Published by the Norman W. Henley Publishing Company, 132 Nassau street, New York. Price $2.

To a great many railroad men this book will need no introduction. The fact that this is the twenty-sixth edition indicates the position which it holds in the railway field. It is a complete treatise on the Westinghouse air brake, including the latest development in the E-T equipment and the P-C passenger brake equipment. The air train signal system is also considered as well as train inspection and train handling. The question and answer form has been followed. Several of the illustrations are full page colored plates.

COMMUNICATIONS

MELTED BOILER TUBES

Topeka, Kan., August 12, 1914.

To the Editor:

In your issue for August, page 397, appears an article on "Melted Boiler Tubes," signed by XYZ, with a note stating that the correspondence explains itself, and that you would be glad to have any of your readers give the details of a similar experience.

Some years ago the writer had a similar experience, which was more damaging than the one in question. This was a Prairie type engine which had been fired up without water. The fire was in the boiler not to exceed forty minutes, when this was discovered. The fire was knocked and there was apparently no damage to the box. In the course of an hour or so it was discovered that some of the flues were red hot. The fire was built at 4 p. m., and at 1 a. m. the stack had the appearance of a cupola casting off molten metal. The boiler had some 360 flues, all of which were melted back to from 6 to 10 in. from the firebox end. The boiler got so hot that the checks were melted off the outside, the front flue sheet was wasted in thickness 1/8 in., and molten metal ran out around the steam pipes and exhaust stand and in the water space of the throat sheet in the firebox; the result was that we had to renew the outside casing of the throat sheet as well as three bottom courses in the boiler. The firebox was not damaged. This firebox did not have any arch tubes or arch brick, so the trouble could not be attributed to heat from the brick arch. I will not try to explain the phenomena, as at the time this occurred there were all kinds of theories advanced, and probably the discussion of the subject in your columns will bring out the real cause.

L. H. Y.

Chicago, Ill., August 13, 1914.

To the Editor:

Referring to the damaging of locomotive boiler tubes and the tube sheet in the front end because of internal combustion, as noticed in the August issue, page 397, I wish to direct attention to a case which occurred on the Chicago & North Western in October, 1909.

We had a small four-wheel switch engine working at Racine, Wis. When in need of a washout, it was taken to Milwaukee, about 23 miles away, on Saturday night. In this particular case it had worked some twelve hours at Racine, before it started for Milwaukee. Owing to a delay caused by a derailed freight car, the engine crew of the switch engine found that the legal working hours would expire before reaching Milwaukee and the despatcher instructed them to leave the engine at Cudahy, about six miles from the terminal and it would then be taken in by a freight train.

The engine crew knocked out the fire and extinguished it as much as they could with water. They left the engine at 9 p. m. with 40 lb. of steam in the boiler and a full glass of water. The engine was towed to Milwaukee some time during the night and was in the yard at the roundhouse at 6:30 a. m. when the foreman looked it over and ordered it moved into the roundhouse, instructing the boiler force to have it washed out and leaving instructions as to what repairs should be made. Shortly after the engine was placed in the roundhouse, the boilermaker foreman advised the general foreman that something was wrong with it. He stated that in making the connections for washing, they found that one of the hand hole plates had been removed some time between the time the engine was left at Cudahy and its arrival at Milwaukee and that when water was allowed to drip into the boiler from the overhead connection, a considerable volume of steam rushed out of the hand hole.

They first looked in the firebox and found no fire whatever but could see a reflection at the front end of the flues. They opened the front door and the flues seemed to be red hot and getting hotter all the while. They closed the front door and took off the boiler check. The check was found to be very hot, but they could not see any fire in the boiler interior. They again opened the front door and the flues immediately began to become white hot and it seemed that a slight blue flame was escaping from around the flues where they were inserted in sheet, indicating that there was gas burning on the inside of the boiler. The front door was again closed and a steam hose was connected from the blower line to the check valve opening in the boiler, permitting the steam to enter the boiler shell. There were some slight explosions, but when the front door was again opened it was observed that the flues were cooling off. The flue sheet, after being cooled, appeared to have been in a fire. It was red, as were the flues extending back from the front end for about 2 ft. The flues were all loose in the sheet; otherwise no damage was done, and after calking the seams at the front end of the boiler, the flue sheet seams, and re-rolling the flues, the engine was again made serviceable.

We did not give this occurrence very much publicity, as it seemed to be rather uncanny. The flues were clean inside and out. The front end had no cinders in it that might catch fire; the firebox was not equipped with a brick arch and I cannot give any reason for this heating but do believe now that admitting steam to the inside of the boiler saved it from the same experience as the one you illustrated in your August number.

E. H. Wade,
Supervisor of Motive Power and Machinery,
Chicago & North Western.

RECLAIMING SCRAP MATERIAL

Amarillo, Tex., August 15, 1914.

To the Editor:

Since the Atchison, Topeka & Santa Fe has placed material supervisors at the different shops we have been able to reduce the material charges about one-half by inspecting all old and second-hand parts and picking out those that may be repaired and used in place of new material. The scrap bins are carefully watched to see that no material is scrapped that can be used. Such parts as globe valves, nuts, bolts, brasses of all kinds, and all kinds of tools are repaired and used. When an over-supply is on hand the surplus is turned in to the store house, and the department thus remitting receives credit for it. Oftentimes piston rods that are removed from large engines may be used on smaller engines; in this case they are sent to the store house and the proper credit is given on the new rods. Bolts of all kinds are reclaimed by straightening and recutting the threads, or in some cases, by cutting them off to a shorter length and rethreading them, they then being used as new bolts. The nuts are reclaimed by rethreading when it is possible to do so.

Many good globe valves are sometimes thrown away when all that is necessary to put them in good condition would be a new packing nut, disc, or perhaps the straightening of the stem. By applying these parts we save the price of the entire valve, which ranges anywhere from 80 cents to $5. Another large item is the matter of rod bushings; when they become a little loose and worn we close them by applying shims and tightening them in the rods, instead of throwing them into the scrap bin. Wrist pins, when they become loose in the crosshead, are removed and turned down for smaller engines; they also make good knuckle joint pins. Wash out plugs which are too small for the original holes, are chased down to a smaller size and given to the boiler washers, who use them instead of new ones. Wheels which are removed on account of rough journals, worn flanges, or shelled parts, are delivered to the store house, credit for them being given, less the amount of labor charges for putting them in good condition. If the tire is too thin and will not stand another turning we get credit for the axle and wheel center.

We have a preparation for polishing the bullseye lubricator glasses when they become black. By keeping them in good con-

dition in this way we have not found it necessary to draw a bullseye lubricator glass from the store house for more than eight months. Flue ends over 6 in. long that are removed from new flues when being applied are sent to the store house and credit for them is received.

Classification lamps, markers, oil cans and shovels, are repaired by our supply man, who puts in new handles, solders up the leaks, or applies new glasses, as may be required. Every Monday morning each mechanic is given a half pound of waste, which is to last him for the week. At first the men thought they could not get along with this amount, but we found that the men who complained the most were not using their waste properly, and soon convinced them that they would be allowed no more. Since that time it has been found that the half pound will last them very satisfactorily. We feel that these material supervisors have saved the company considerable money, and their expense is fully warranted by the work they do.

C. G. COATES.

SPRING VERSUS FRICTION DRAFT GEARS

HARVEY, Ill., August 13, 1914.

TO THE EDITOR:

In reading your editorial and other writers' views on the draft gear problem as published in the July and August issues, it appears to me that the friction draft gears have been overestimated. We have in this country two classes of cars, passenger and freight, and to illustrate this more forcibly I have compared them with the home dog and the tramp dog. The home dog (the passenger car) is fairly well taken care of according to the ability of its master. The tramp dog represents the freight car and he is kicked from one place to another and nobody cares whether he has any nourishment or shelter—even at a bumping post—the main thing being to get him off one's hands without giving him anything. The draft gear represents the energy in keeping him moving and, when he has lost this energy, he is a dead dog; same with the freight car.

Much has been written and more has been said on the draft gear question than on any other part of the car, and less has been accomplished, because no conclusions have been reached whereby any body of men could agree on the essential points, which are, the capacity for absorbing and destroying shocks; initial resistance to permit an easy starting of the train; flexibility between maximum and minimum, because of its effect on the drawbar pull and buff to prevent break-in-twos.

As a rule draft gears are purchased on the recommendation of the mechanical engineer, who has gone over the various laboratory tests. Alas, the gear that showed such beautiful geometrical curves while under the care of the mechanical engineer in the laboratory is smashed to smithereens by a switchman when put to actual service conditions. When a draft gear is applied to a car, every known laboratory condition is changed, there being no feature surrounding the service test corresponding to that by which the results shown on the graphic charts were produced. Even when cars are on a tangent or straight track, the impact or blows resulting from two cars coming together are seldom, if ever, under the same conditions that would obtain with a single gear in a testing machine.

It is well known that there is a vast difference between a mechanical engineer and a railway switchman; the former takes one single gear into the laboratory and takes the time necessary to very carefully and gently compress it. On the other hand, the switchman is less careful. He throws a cut of loaded cars down against other cars standing still with the usual high sign (put them into clear), which means at speeds of from five to ten miles an hour, and sometimes more, and it is all done in less than a second. Such shocks could never be absorbed or destroyed by any draft gear, whether friction, spring or any other sort.

Thus we are forced to admit that we are unable to entirely absorb or destroy the shocks with any kind of a draft gear. The underframe must do it or the car is out of commission. The only thing that can be done is to furnish sufficient resistance for ordinary running conditions; this should be, under present conditions, not less than 100,000 lb. The average tractive effort of road engines does not exceed 60,000 lb. The average tonnage trains do not exceed 3,000 tons per train.

I, therefore, favor higher capacity spring gears. Spring gears properly applied will retain their capacity, while friction gears will wear out. I have seen many of them with absolutely no resistance whatever; still, the trainmen will pull them and the inspectors will pass them as long as they hold together. They move from one end of the pocket to the other, just like a solid block, producing more lost motion in a train than the link and pin arrangement ever did, because of the greater drawbar travel of the friction gears.

The friction draft gear people say the slack should be taken up as fast as it wears out. That is true, but is it? Not that I have noticed. I made an inspection of 150 cars equipped with friction draft gears a short time ago that were standing in the yard bunched together, and I found that an average of one out of every five cars had the horn of the coupler solid against the head blocks. This proved to me conclusively that either the friction parts were worn out, or that there was not sufficient recoil in them to move them back to normal position. That the friction draft gears show up better in the train and laboratory tests when new is entirely due to the difference in capacity, but they fall far short of the mark after a year or two of actual service. Obviously where there is friction there is wear, and the higher the resistance the faster the wear. I find this to be the case even with the coupler carry irons, which only carry the weight of the couplers. What must it be with a draft gear that has a resistance 500 times greater than the weight of the coupler?

In the laboratory tests given by Mr. Newell, a 9,000 lb. weight falling 5½ in. closing the most powerful draft spring solid, shows discrimination between the spring and friction gears, as no one would use a single spring gear at this date when four or more double coil springs may be used in each end of the car. Put four of the same springs in a group and the result will show four times greater and the springs will retain their resistance for the life of the car, while the friction gears will not.

The greatest argument against the spring gears is a supposed recoil, but recoil we must have, or we have no draft gear. If the recoil is as great as some people say it is, some of our trains would be aeroplanes, as no one hesitates to place sufficient springs in the trucks of cars to properly carry the load. I have seen people place a 30,000 lb. spring in a testing machine and drop a 9,000 lb. weight on it at various heights and watch it rebound. But, if these people would only drop a 50,000 lb. weight on the same spring, the result would be entirely different. It would fall dead.

The best results that were ever obtained in railroad train service, as I remember it, was when the springs in the end of the cars exceeded the carrying capacity of the cars. The trouble today is that the capacity of the cars exceeds the capacity of the draft gear, be it either of the spring or friction type. To satisfy yourself of this fact, go out in any yard when tonnage trains are pulling out and you will find 90 per cent of the draft gears stretched out absolutely dead by a locomotive with a tractive effort of less than 60,000 lb.

It is generally conceded that as soon as the friction faces become polished the gear loses half of its original resistance, but it is not admitted that it falls below the tractive efforts of an ordinary road engine.

It is not a question today of having sufficient drawbar travel to start freight trains, but it is a question of having an engineer that can start a train without breaking it in two, due to excessive drawbar travel. The principle is wrong, the resistance should be increased and the drawbar travel should be reduced to produce results without depending on the engineer's

judgment as to how much slack he can take with safety, and not lose his head trying to clear some passenger train only to find that his train had parted and caused a greater delay.

At the January 20, 1914, meeting of the Western Railway Club, the subject of freight train handling was discussed. The whole evening was consumed in the discussion of air brakes versus slack in trains, but no one produced a remedy for the existing slack.

In summing up, I am satisfied, notwithstanding what has been said to the contrary, that it is still a mechanical problem and must be solved by the mechanical department, as far as running conditions are concerned—these must be made fool-proof. But, yard conditions and smashing cars on the road by careless trainmen in switching is entirely up to another department.

H. C. PRIEBE,
Chicago Steel Car Company.

BRACING OF BOILER HEADS

PHILADELPHIA, Pa., July 21, 1914.

TO THE EDITOR:

I was much interested in the article of W. N. Allman, on Boiler Construction, in the March number, and the subsequent discussion of the matter in your May issue.

Mr. Allman is correct, regarding the unsupported area of back head and tube sheet, when he says that there are many views on this matter. The fact that there are many views, and that they conflict as they do, shows pretty conclusively that all cannot be right; and what follows is not written in a spirit of controversy, but from a desire to present for the benefit of others some considerations which have settled this question for me. It will be evident that the Ohio and Massachusetts state rules, deducting 3 in. from the outside of the flange to cover what the flange will carry, can only properly and consistently apply within certain limits of thickness of plate, radius of flange and pressure to be carried. It is not logical, for instance, to say that the flange of a head 1¼ in. thick will only carry as much as the flange of a head 5/16 in. thick. Nor is it any more rational to admit that, if a head 36 in. in diameter has a flange radius of 18 in. outside, it requires no bracing for loads proportionate to its thickness, but if the radius of the flange is 9 in. it must be braced for all its area except 3 in. around the outside, just the same as if the flange radius were ½ in. Similarly one need hardly state a case to see that the flange of a flat head, say ½ in. thick, can support a pressure of 60 lb. much further in from the flange than it can a pressure of 300 lb. with equal safety.

The formula used by the British Columbia Boiler Inspection Department has the merit of providing for each of these varying conditions, and the writer has compared it with the practice used for years by one of our largest locomotive manufacturers and finds that they substantially agree. As given in their book of boiler rules, the formula is preceded by the following statement: Segments of boiler heads above or below tubes to be supported by stays or braces. When the head is flanged and riveted to the shell, a portion of it becomes stiff enough to carry the boiler pressure without depending upon the braces. The distance that thus becomes self-supporting may be determined by the following formula: The allowance for shell as stay to head to equal

$$\tfrac{1}{2}\sqrt{\frac{125 \times (T+1)^2}{\text{Pressure}}} + \text{radius of curvature of head flange,}$$

T being the thickness of the plate in sixteenths, and 125 being a constant.

For a ⅜ in. thick head, 200 lb. pressure and ½ in. radius flange this gives an allowance of 3¼ in.; while for a ½ in. head, 200 lb. pressure and 3 in. radius of flange the allowance becomes 6 9/16 in. When the bracing of the flat portion of the head is done by rods through from head to head, or by crow feet riveted to the head, as used to be common practice, the amounts given by this formula can be safely allowed, but should not be exceeded. When, however, as is now common practice, the flat portion of the head is braced by heavy section steel tees, even these limits may be considerably exceeded with perfect safety. This serves to illustrate the folly of attempting to govern by fixed rules a business that is still developing. Standardization is good where interchangeability is desirable, but to carry it to extremes is to entirely paralyze progress.

Consider the head of the locomotive boiler shown in Fig. 1, the radius of the flange varying from about 3 in. at the top to about 6 in. at the side center line. The drawing shows an arrangement of rods and tees for bracing the flat surface. The dot and dash line *R R* marks the edge of the radius portion and the beginning of the flat portion of the plate, and the line *D D* is taken midway between the upper row of screw stays and the lower rivets on the tees; S_1, S_2, S_3, etc., indicate the segments forming the flat portion of the head, each having one or more brace rods and each being stiffened by a 6 in. by 5¼ in. steel tee, riveted to the head. The modulus of this tee section is 8.19 and on a 15 in. span (the distance in this case from the lower rod to the upper end of the tee) its safe distributed load is 69,920 lb., which it will be seen by what follows is much in excess of any load that can come upon it.

The area of the segment S_1 equals 187 sq. in., and at 200 lb. pressure the load upon it is 187 × 200 = 37,400 lb. The center of this load is the center of gravity of the segment, a point

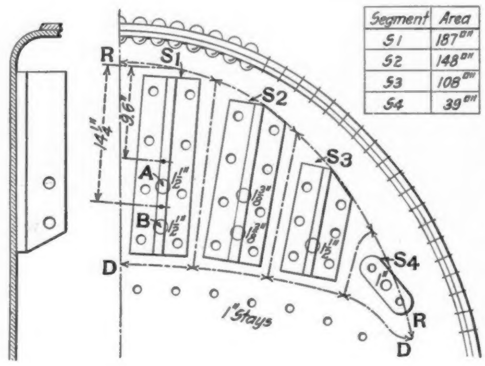


Fig. 1

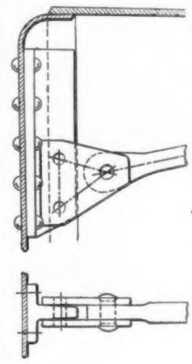


Fig. 2

about 9.6 in. in from the outer edge of the flat portion of the plate and at the center of the width of the segment. The distance from the outer edge of the flat portion of the plate to the center between the two rods *A* and *B* is 14¼ in. Then, assuming that the plate and tee act as a lever pivoted at the most flexible place in this portion of the head, that is, just inside the line *R R*, we will have 37,400 × 9.6 ÷ 14.25 = 25,195 lb., the load at the center between the rods *A* and *B*. The combined area of these two rods, which are 1½ in. in diameter, is 3.534 sq. in. Then, assuming an equal distribution of the load on both rods, we will have 25,195 ÷ 3.534 = 7,129 lb. per sq. in. on each. If, however, from various inequalities of position, length of rod or initial tension there should be 1½ times as great a load on *B* as on *A*, we would have 5,703 lb. per sq. in. on *A* and 8,555 lb. per sq. in. on *B*, which is still within safe working limits, as set by the boiler inspection department of the Interstate Commerce Commission.

The load on the flange rivets is equal to 5,775 lb., the direct steam load on the radius portion of the flange opposite S_1, plus the difference between the total load on the segment and that part of the load carried by the rods, or 5,775 + (37,400 − 25,195) = 17,980 lb. Then 17,980 ÷ 5½ (the number of rivets opposite segment S_1) = 3,270 lb. per rivet. As a ⅞ in. rivet shears at about 26,457 lb., we would have 26,457 ÷ 3,270 = 8.09 as the factor for rivet shear. The 17,980 lb. is transmitted to the rivets by a section of flange over 10 in. long, which is equivalent to about 1,798 lb. per in. of flange length.

In passing it may be noted that the 17,980 lb. which is transmitted to the flange represents the load on 90 sq. in., and as

the segment is about 10 in. wide, this amounts to transmitting the load on the outer 9 in. to the flange. The amount of load that is thus transferred to the shell through the flange may cause some minds to question whether by repeated stresses due to fluctuations of the pressure the flange may not be finally affected injuriously. An analogous case may shed the light of experience here. When a dished head is placed in a steam drum it is subjected to just such variations of load and careful measurements will show that under heavy loads such a head yields considerably. The writer recalls one case of a drum about 34 in. in diameter, whose dished head he measured under test several years ago. It was found that the dish deepened over 5/16 in. under pressure, but returned to normal on the release of the load. Under ordinary working conditions this head must give quite perceptibly, as must hundreds of other similar heads, and no trouble has developed, nor is it at all likely to, provided loads are kept within reasonable limits. As a head dished to a radius equal to its outside diameter is equal in strength to a cylindrical shell of the same thickness and diameter, if we determine the diameter of drum for which, say, a ½ in. steel plate is safe under a given pressure, we will have a fair idea of what is a reasonable load for a head flange ½ in. thick. Assuming a tensile strength of 55,000 lb. and a seam efficiency of 91 per cent, what diameter shell can we make to carry 200 lb. working pressure with a factor of five? Diameter $= 55{,}000 \times 0.5 \times 2 \times 0.91 \div 5 \times 200 = 50$ in. The area of a 50 in. head is 1,963.5 sq. in. The load on the head is $1{,}963.5 \times 200 = 392{,}700$ lb. Dividing by 157, the circumference of the flange, we obtain 2,500 lb., which is the load per inch of flange length. If we now take a load of 2,000 lb. per inch of flange length for our backheads we will surely be safe.

There are some state laws which will not admit of a load of 9,000 lb. per sq. in. on brace rods, allowing 7,000 to 8,000 lb. per sq. in. on weldless steel and only 6,000 lb. on welded iron rods. Twenty-five years' experience with boiler design convinces me that it is a serious mistake to plan rigid bracing on heads or tube sheets. The expansion of the tubes, and especially of the firebox in the case of the locomotive boiler, constitutes forces that are destructive if opposed. That is ideal bracing, which, while affording ample support against the steam load, will yet yield, as a spring does, to a greater load. The stretch of a brace rod 10 ft. long, loaded to 9,000 lb. per sq. in., is 0.036 in.; and a firebox having a crown 54 in. long at a temperature 100 deg. F. greater than the outer sheet will expand just as much. Inasmuch as greater temperature differences are probable, and crown sheets are more frequently longer than shorter than 54 in., the need of elasticity in the adjacent bracing is evident.

For a number of years it has been my habit to ask of inspectors and master mechanics the question: "Do you know of any case of boiler failure due to head or tube sheet brace rods?" and the answer has been invariably, "No." We did have in Philadelphia many years ago a boiler explosion due to the head giving way, but it was a cast iron head, and we believe unbraced at that; but since the advent of flanged steel the failures from weakness in heads have been few, if indeed there have been any.

There may still be those who think, notwithstanding what has been said, that a larger number of smaller rods distributed over the tees would be better than the arrangement shown. With three or four rods fastened to one tee, varying in length, say from 3 ft. to 12 ft., it is practically impossible for a workman to so adjust the tension on the various lengths that each will bear a proportionately equal share of the load when under pressure. It is common to consider that the deflection of the tee will equalize the loading, but when we figure the deflection between any two rod centers and find the figure in the fourth decimal place, it is evident that so small an amount is not worth considering. When there are only two rods to a tee, however, by giving the longer rod the greater initial tension, we can successfully approximate an equalization in the loading.

An almost ideal method of bracing would be with one rod only, as shown in Fig. 2. One mild steel rod may be made large enough to carry the load, and there could be no debating the question of distribution. Welding could and should be avoided, as it would only be necessary to upset either end of the brace to form an eye. Two pieces of boiler plate would form a jaw and an equalizer combined. With a large steel rivet in the eye of the rod and two smaller ones through the web of the tee, such a construction would be as secure as a bridge. By moving the point of attachment further up or down the tee, the proportion of load carried by the rod and the head flange could be varied at will. Corrosion would bear such a small relation to the area of the brace that it would almost cease to be a factor. No doubt there will be objection made by some to transmitting so much load to one point on the shell, but there is nothing new about that. The Pennsylvania Railroad have for some years been fastening two rods to one point in the shell, the rods being attached one over the other to a bent steel plate. The writer has frequently accomplished the same purpose by the use of a piece of steel tee riveted to the shell, the rods being fastened one ahead of the other on the tee.

There is not only no reasonable objection to, but on the contrary there is a good reason for a concentration of longitudinal stress behind and before the opening in the shell at the dome. The circumferential stress at this point is transmitted diagonally on either side of the opening, and tends to pull the dome opening together longitudinally, just as it tends to stretch it circumferentially. The leakage which frequently gives trouble around the dome results from this action. If, however, we had two equal and opposite longitudinal forces at the front and back of the dome opening, and of the same magnitude as the circumferential forces at this point, there would be a complete balancing of load and no tendency to distortion. There is no danger of too much concentration of load here; the only trouble is that we cannot get enough to balance.

Any one can by a simple experiment note the effect described; take a sheet of paper, cut a liberal sized opening in it, pull in the direction of the length of the paper, and note the puckering edges around the opening. Then while you pull, get some one else to pull at right angles, and note how the sheet straightens when the tension is balanced.

Why should we waste thousands of dollars annually putting junk into a boiler? In a recent locomotive boiler design it was noted that there were 18 extra and unnecessary rods on the backhead and 10 equally unneeded rods on the front tube sheet, but what advantage to safety is this excess of strength when, out of 97 locomotive boiler failures reported by the Interstate Commerce Commission in one year, there were none due to failure by bracing, while 94 of the 97 were crown sheet failures, the other 3 being failures of lap seam shells?

Thomas H. Walker.

Denatured Electricity.—An interesting method of preventing the improper use of electric current has been devised by an Italian engineer. The practice of making especially low rates for current to be used in heating and cooking devices and for electric power is becoming general, but with the ordinary constant potential current it is difficult to detect the use of lighting devices on circuits intended only for other purposes. By the use of special circuits on which the current is subject to extreme fluctuation of voltage at rapidly recurring intervals the application of this current to lamps is made practically impossible because of the flicker in the light. As the current is not entirely interrupted, however, and the normal voltage is almost immediately restored, the proper operation of power or heating apparatus is not interfered with and the rightful use of the circuits for their respective purposes is assured.—*Machinery.*

LARGEST NON-ARTICULATED LOCOMOTIVE

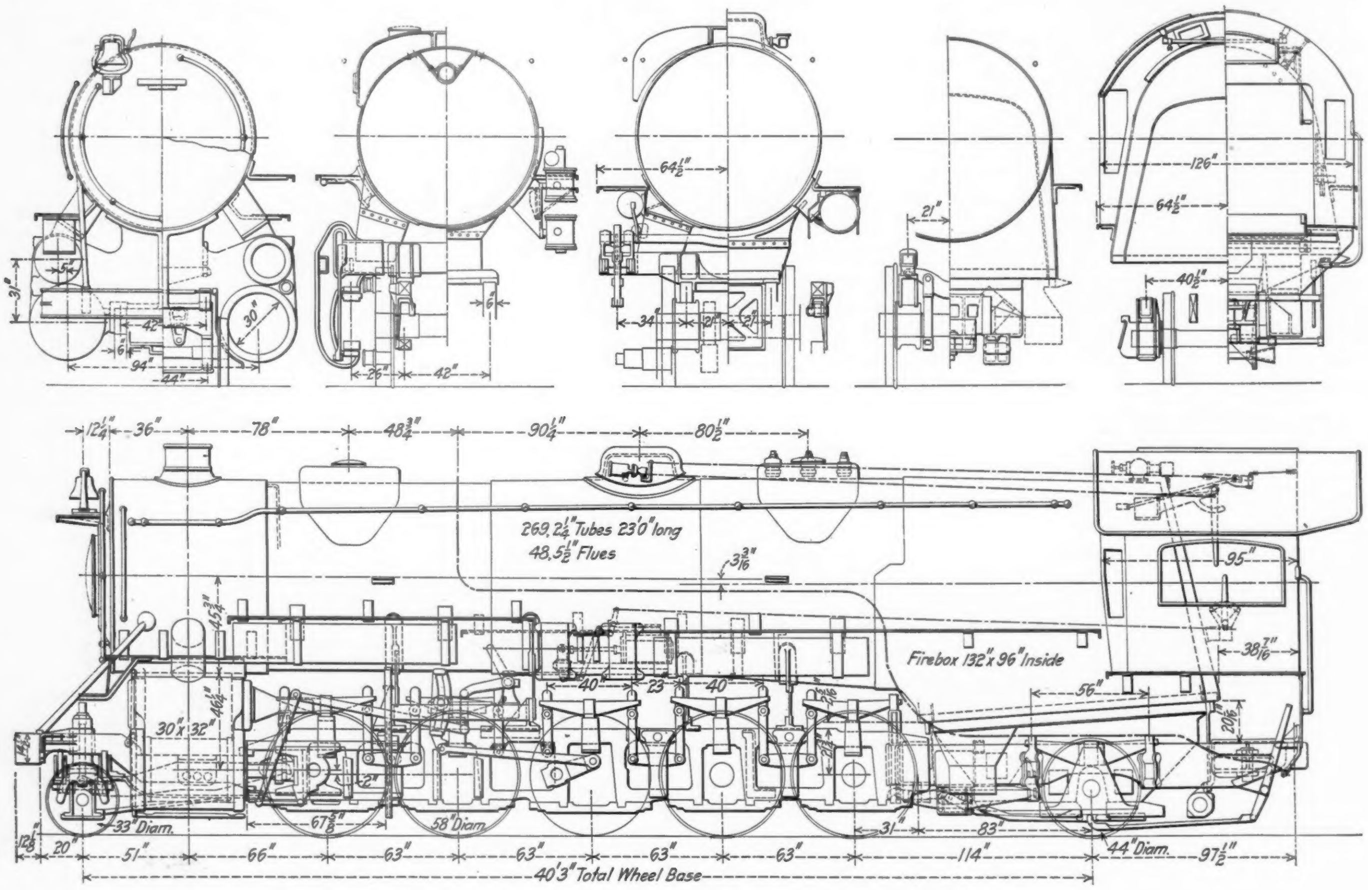
Baltimore & Ohio 2-10-2 Type Has Total Weight of 406,000 lb. and Develops 84,500 lb. Tractive Effort

With the Santa Fe or 2-10-2 type locomotives built in 1912 by the Baldwin Locomotive Works for the Chicago, Burlington & Quincy* it was believed that the limits had been reached in locomotives having a single set of drivers. A considerable advance both in total weight and in tractive effort has been made, however, in a locomotive of this type recently built by the same company for the Baltimore & Ohio. This locomotive will develop a tractive effort of 84,500 lb., which exceeds that of many Mallet articulated locomotives of the 2-6-6-2 type.

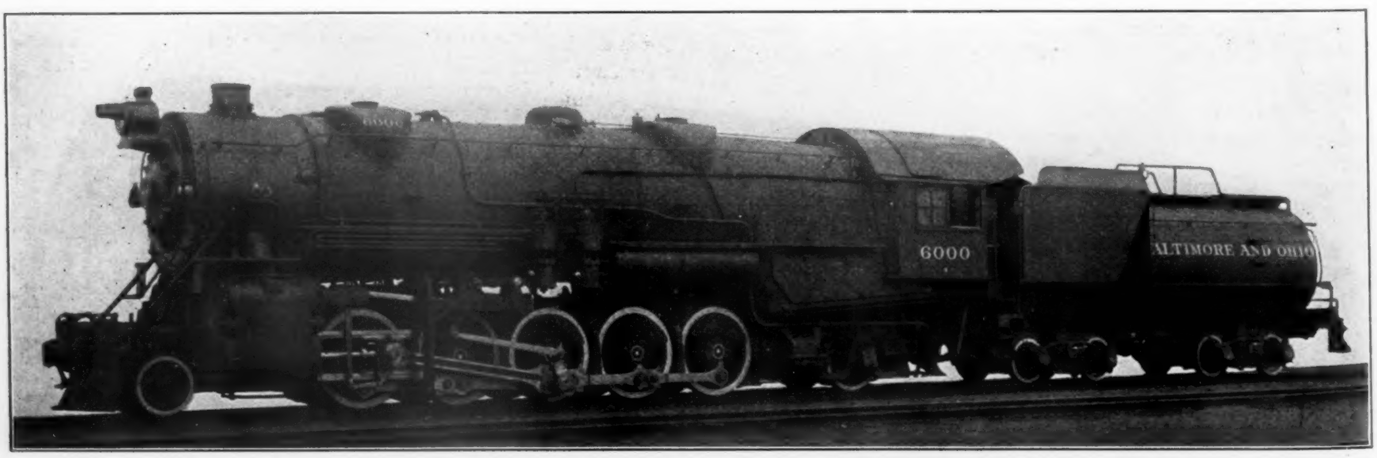
*See *American Engineer*, May, 1912, page 31.

The boiler is of the straight top type with a combustion chamber 28 in. long and tubes 23 ft. long. The third ring in the barrel is tapered, with the slope placed on the bottom in order to give a free entry to the throat. The equipment includes a Security sectional arch and a Street mechanical stoker. The superheater is of the Schmidt type, and is composed of 48 elements. The dome is of pressed steel 33 in. in diameter and 12 in. in height.

The cylinders are each cast in one piece with a half-saddle, and the castings are bolted to the smokebox and to each other



Longitudinal and Sectional Elevations, Baltimore & Ohio 2-10-2 Type Locomotive



Heavy 2-10-2 Type Locomotive for the Baltimore & Ohio

by double rows of 1¼ in. bolts. The steam distribution is controlled by 16 in. piston valves, driven by Walschaert motion and set with a lead of ¼ in. The valves have a steam lap of 1¼ in., and are line and line on their exhaust edges; the Ragonnet power reverse mechanism is applied. No vacuum relief valves are used, but the cylinders are equipped with by-pass valves of the Sheedy pattern.

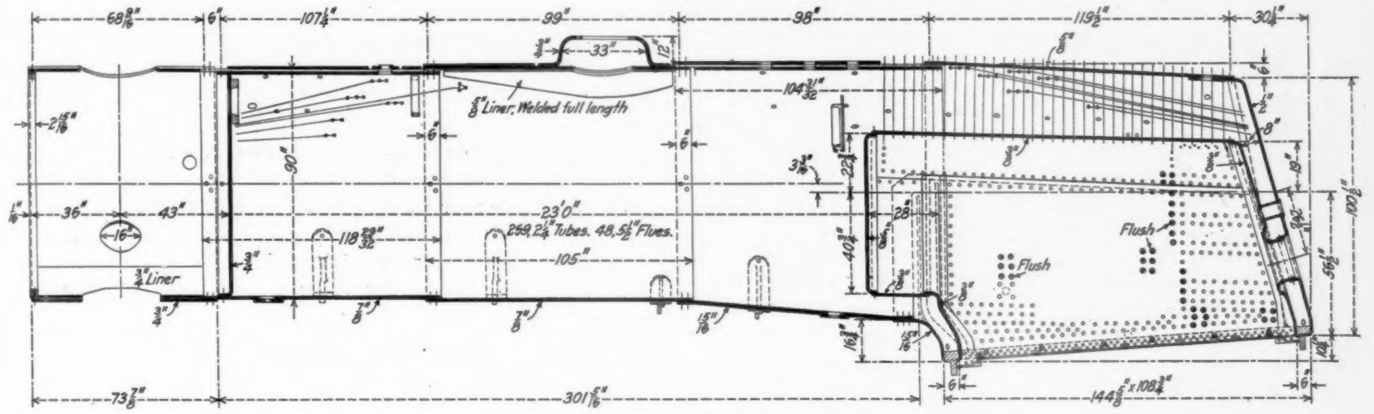
The cylinders and steamchests are lined with bushings of Hunt-Spiller metal, and the piston and valve packing rings are of the same material. The pistons are steel forgings, of dished section, and are fitted with bull rings of Hunt-Spiller metal. These rings are secured to the pistons by retaining rings, which are electrically welded in place.

A total lateral play between the rails and flanges amounting to 1 in. is allowed on the front and back driving wheels, while the play on the second and fourth pairs is ¾ in. The wheels of the third or main pair have plain tires, and all the driving wheels have a lateral play of ¼ in. in the boxes. These provisions for flexibility are necessary in order that the locomotive can traverse the sharp curves on the mountain divisions of the Baltimore & Ohio.

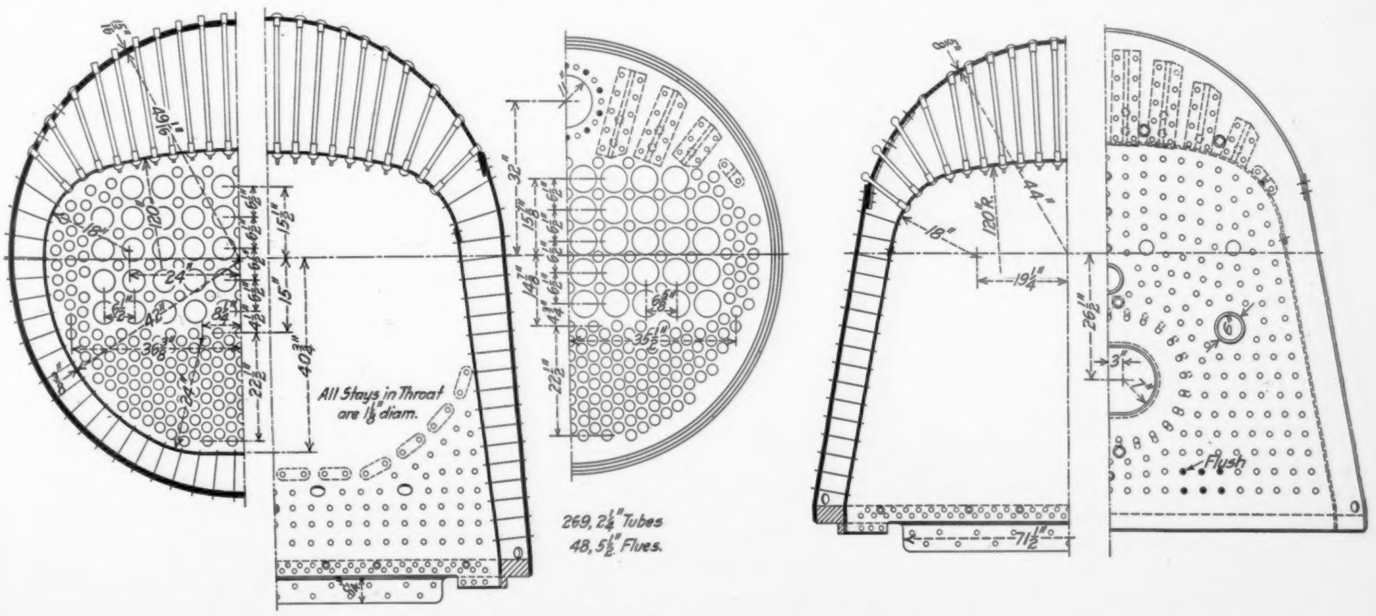
The frames have a width of 6 in. and a depth over the driving pedestals of 7 in. The frames are braced transversely by the guide yoke and valve motion bearer; also by crossties placed respectively over the fourth pair of driving pedestals, and between the fourth and fifth pairs of driving wheels. The second and fourth pairs of pedestals are also braced by steel castings which extend the full depth of the frames. The rear frame sections are spliced to the main frames immediately back of the rear driving pedestals, and are braced by a steel casting which serves the triple purpose of a crosstie, a support for the front end of the firebox, and a carrier for the radius bar pin of the trailing truck. The main frames have single front rails, 13 in. deep, cast integral with them.

The trailing truck is of the Hodges type, with the spring hangers placed at an angle so that they will swing in planes tangential to the arc in which the truck swings. The first and second pairs of driving wheels are equalized with the leading truck, and the three remaining pairs with the trailing truck.

In designing this locomotive, care was necessary in order to keep the overall dimensions within the specified clearance limits. The bell is mounted on the righthand side of the smokebox front, on a level with the headlight. There are four sandboxes, two for use when going ahead and two for backing up. They are mounted right and left, on the top of the boiler, and the corners are rounded to keep within the tunnel clearances. For the same reason the cabroof is rounded with a comparatively short radius. The tender is of the Vanderbilt type, with capacity for 10,000 gal. of water and 16 tons of coal.



Boiler for the Baltimore & Ohio 2-10-2 Type Locomotive



End and Sectional Elevations of the Boiler

The following are the principal dimensions and data:

General Data

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal
Tractive effort	84,500 lb.

Weight in working order	406,000 lb.
Weight on drivers	336,800 lb.
Weight on leading truck	22,700 lb.
Weight on trailing truck	46,500 lb.
Weight of engine and tender in working order	584,000 lb.
Wheel base, driving	21 ft. 0 in.
Wheel base, total	40 ft. 3 in.
Wheel base, engine and tender	76 ft. 6 in.
Ratios	
Weight on drivers ÷ tractive effort	3.99
Total weight ÷ tractive effort	4.81
Tractive effort × diam. drivers ÷ total equivalent heating surface*	647.80
Total equivalent heating surface* ÷ grate area	86.00
Firebox heating surface† ÷ total equivalent heating surface,* per cent.	4.27
Weight on drivers ÷ total equivalent heating surface*	44.52
Total weight ÷ total equivalent heating surface*	53.66
Volume both cylinders	26.2 cu. ft.
Total equivalent heating surface* ÷ vol. cylinders	288.8
Grate area ÷ vol. cylinders	3.36
Cylinders	
Kind	Simple
Diameter and stroke	30 in. by 32 in.
Valves	
Kind	Piston
Diameter	16 in.
Outside lap	1¼ in.
Inside clearance	Line and line
Lead in full gear	¼ in.
Wheels	
Driving, diameter over tires	58 in.
Driving, thickness of tires	4 in.
Driving journals, main, diameter and length	13 in. by 13 in.
Driving journals, others, diameter and length	11 in. by 13 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	6 in. by 10 in.
Trailing truck wheels, diameter	44 in.
Trailing truck, journals	8 in. by 14 in.
Boiler	
Style	Straight top
Working pressure	200 lb.
Outside diameter of first ring	90 in.
Firebox, length and width	132 in. by 96 in
Firebox plates, thickness	⅜ in.
Firebox, water space	6 in.
Tubes—number and outside diameter	269—2¼ in.
Flues, number and outside diameter	48—5½ in.
Tubes, length	23 ft.
Heating surface, tubes	5,215 sq. ft.
Heating surface, water tubes	35 sq. ft.
Heating surface, firebox	258 sq. ft.
Heating surface, combustion chamber	65 sq. ft.
Heating surface, total	5,573 sq. ft.
Superheater heating surface	1,329 sq. ft.
Total equivalent heating surface*	7,566 sq. ft.
Grate area	88 sq. ft.
Tender	
Tank	Vanderbilt
Wheels, diameter	33 in.
Journals, diameter and length	6 in. by 11 in.
Water capacity	10,000 gal.
Coal capacity	16 tons

*Total equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.
†Including combustion chamber heating surface.

ABATING SMOKE AND INCREASING EFFICIENCY WITH HAND FIRING

The following rules to aid in abating smoke and to increase efficiency with hand firing, are from Appendix IV of Bulletin No. 8, entitled, "Some Engineering Phases of Pittsburgh's Smoke Problem," issued by the University of Pittsburgh.

1. Fire evenly and regularly.
2. Fire moderate amounts of coal at a time and place the coal where it is needed.
3. Keep the fire clean, even and bright all over; do not allow it to burn into holes or thin spots.
4. Break up the lumps and have the coal as nearly as possible uniform in size. Do not fire any lumps larger than a man's fist.
5. When a fire has burned into holes, do not throw green coal on the bare grates, but push incandescent fuel into these spots before firing.
6. Regulate the draft and air supply to suit the fire.
7. Watch the condition of the fire and the steam gage together. Do not fire large quantities of coal.
8. Do not level or stir the fires unless absolutely necessary, and then use the utmost care.
9. Do not allow ashes and clinkers to accumulate on the side or bridge walls, as this cuts down the effective grate area, and causes other troubles.
10. Do not allow too long intervals between firings.

PREDETERMINATION OF LOCOMOTIVE PERFORMANCE

BY PROF. ARTHUR J. WOOD
The Pennsylvania State College

The use of the method to be discussed was first suggested in connection with problems in steam railroad operation in 1890 in Goodwin's "Railroad Engineers' Field Book." The application of the "speed-time" curves in electric railroading has been thoroughly developed by C. O. Mailloux,* A. H. Armstrong and other engineers and the theory applied to steam road conditions was explained by "G. E." in the American Engineer and Railroad Journal, November, 1911. The method, in outline the same as used for electric railroads has been applied by the writer to a few practical cases of steam railroad operation with satisfactory results; and problems of this kind have been completely worked for the writer by S. M. Dean and by other mechanical engineering students. Attention may be called to a study of characteristic curves presented by Prof. W. E. Dalby before the Institution of Mechanical Engineers in October, 1912, and published in Engineering, November 1, 1912.

The problem before us is to find by graphical methods the

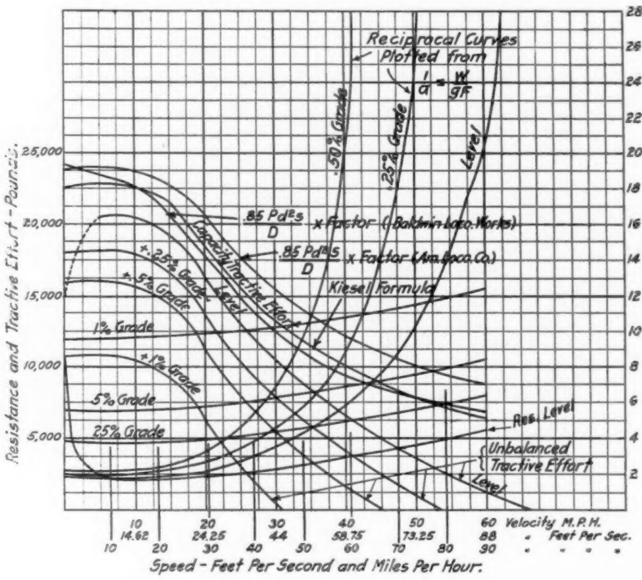


Fig. 1—Characteristic Curves

least time in which a locomotive can haul a train of known weight over a given road bed. This may readily be solved knowing only a few leading dimensions of the locomotive, the weights moved and the grades and curves over which the run is to be made. Starting with calculated tractive force at different speeds, a family of curves is drawn, easily understood and each significant in train operation.

At the outset, we find that the problem for steam railroads differs from that for electric traction in that the tractive force exerted on a train may be maintained at a nearly constant value by electric motors from start up to the normal running speed of the train. The conditions are quite different with a steam locomotive. From start up to 50 or 60 revolutions per minute, the tractive force exerted by a locomotive is practically constant, the boiler supplying steam without drop in pressure. As the speed increases, the cut-off must be reduced in order to maintain steam pressure, the result being a decrease in tractive effort. The controlling factors determining the curve of maximum tractive force in steam operation are the weight on the drivers and the maximum boiler power. The weight on drivers is the controlling factor in electric traction.

The method for solving the problem, in outline, is as follows:

*See Transactions American Institute Electrical Engineers, Vol. XIX, 1902.

(1) Draw the tractive force and resistance curves, finding for level track and on grades the available force at different speeds behind the tender. These may properly be termed the "characteristic curves" of a locomotive.

(2) From results in (1) draw for level and for grades a "reciprocal" curve, which is a curve for different speeds, derived from the fundamental dynamic relation between the force F, acting on a mass M, producing an acceleration a, that is

$$F = Ma \text{ or } \frac{1}{a} = \frac{M}{F} = \frac{W}{Fg} = \frac{W}{F \times 32.16}$$

where F, the force, and W, the weight acted upon, must be in same units. This will be a curve drawn from the reciprocal of the acceleration for different speeds.

(3) Since velocity, $v = at$, the time, $t = \frac{l}{a} \times v$ (for uniform increase in speed) represents an area, obtain the time to accelerate the train by finding the area in proper units under a limited part of the reciprocal curve.

(4) Since $S = vt$, obtain distance S, traveled in time t, by finding the area under the time speed curve.

(5) By aid of a profile map of the road, lay-off the time-speed and time-distance curves for the train considered, by aid of curves for level and grades in (3) and (4) above.

Speed-time curves not only show the speed attained at any given interval of time, but they also show the variations in speed occurring at various intervals of time. The slope of a speed-time curve at any time-point is an indication and a measure of the time rate of change of speed at the corresponding instant of time; and it shows whether the speed is constant, is increasing or decreasing. A horizontal speed-line indicates constant or uniform speed. An upward slope in the speed-line indicates increasing speed, or acceleration; a downward slope indicates decreasing speed or deceleration. These characteristics serve to distinguish the different kinds of speed-time curves.

A PROBLEM SOLVED

Division of road considered		Huntingdon to Tyrone, Pa. (a distance of 19.7 miles)
Locomotive used		Atlantic Type, E2d
Locomotive and tender, total weight		140 tons.
Train composed of seven steel cars	one B60	55 tons.
	one M70	69 tons.
	five P70	306 tons.
Total		570 tons.
Weight on the drivers		61 tons.
Boiler pressure = P		205 lb. per sq. in.
Diameter of piston = d		20.5 in.
Diameter of drivers = D		80 in.
Stroke piston = s		26 in.
Total heating surface		2,640 sq. ft.
Steam		Saturated.

To illustrate the method, calculations are shown for .25 per cent grade and 30 m. p. h.

Tractive Effort and Resistance Curves.—It is first necessary to draw the tractive effort curve of the locomotive:

$$\text{T. F.} = \frac{.85Pd^2s}{D} \times \text{Speed Factor.}$$

Where P is the boiler pressure, in pounds per square inch; d, the cylinder diameter, s, the cylinder stroke, and D, the driver diameter, all in inches. This well known equation may be applied, using speed factors of the American Locomotive Company or of the Baldwin Locomotive Works. To show how they differ, both are drawn in Fig. 1. The reader should note that the above gives values of the force at the rim of the drivers and does not include internal resistances of locomotive or head-wind resistance. The writer has preferred for this study to use the formulas developed by W. F. Kiesel, assistant mechanical engineer, Pennsylvania Railroad, for both tractive force and for resistance on level and on grades.* Mr. Kiesel's formula for the E2d class reduces to,

$$\text{T. F.} = \frac{53305}{1 + .0873V} - (22 + .15V)61 - .1V^2$$

Where V is the velocity in miles per hour, and $T\ F$ the capacity tractive force or draw-bar pull behind the tender. The part to the right of the fraction includes locomotive internal friction and wind resistance.

The resistance curves for the cars hauled were plotted from the following, which may be used for any make up of train, grade and curvature.

R = Total resistance in pounds = $100N + (1.5 + C + 20G)W + .01V (V + 16) \sqrt{WN}$.
V = Speed in miles per hour
N = Number of cars.
G = Grade (per cent.).
C = Curvature in degrees.
W = Total weight of cars in tons.

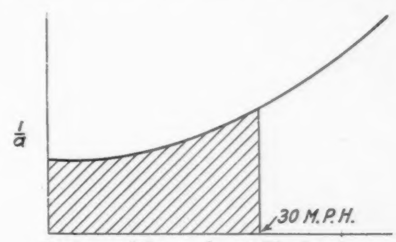
Fig. 1 shows resistance curves for level track and for three up-grades. The formula is applicable also to down-grades.

Unbalanced Tractive Effort Curve.—The unbalanced tractive effort at any velocity will be the difference between tractive effort values taken from the tractive effort curve and the values of resistance taken from the resistance curve. Therefore, to lay off the unbalanced or available tractive effort curves at different speeds, step off the distance between the tractive effort curve and the resistance curve for the grade in question and lay off these distances from the base line. These distances represent for different speeds the force available to accelerate the train and to overcome resistances not already taken into account. Where this curve and the base line intersect (which will be vertically below the intersection of the tractive effort and the resistance curves) will give the balancing or limiting speed, that is, the highest possible speed which could be reached, if the train runs under the conditions fixed by these intersecting curves.

Reciprocal Curve.—Since,

$$F = Ma, \frac{1}{a} = \frac{W}{Fg} = \frac{W}{F \times 32.16}$$

Where F is the pull or force (in pounds) from the unbalanced tractive effort curve, W, the weight in pounds of the train, including locomotive and tender, + 6 per cent of the weight of train. This additional 6 per cent takes care of the force required to overcome the inertia of the rotating parts during acceleration,



Reciprocal Curve for .25% Grade.

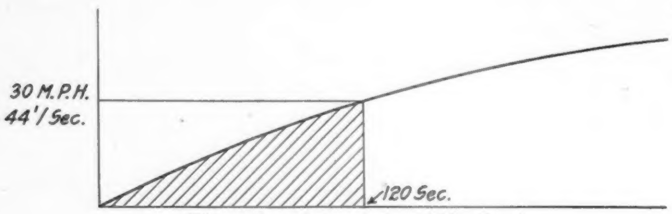
and is an average value for widely varying conditions. The reciprocal $\frac{l}{a}$ of the acceleration is plotted for varying speed differing by ten-mile units.

Time-Speed Curves (Fig. 2).—The time-speed curve is used to determine the speed possible for a locomotive to haul the train in a given time. It is plotted with velocities as ordinates and corresponding time elapsed as abscissas. The time corresponding to a certain velocity is found by taking the area under the reciprocal curve between two velocities, a convenient interval being a difference of ten miles per hour. This is applying the general equation, $dt = \frac{l}{a}\, dv$. Suppose the plot of the reciprocal of the acceleration was made so that the larger of the unit squares into which the cross-section sheet is divided, equaled 2.0 (vertical scale) and the horizontal unit is five miles per hour, or 7.31 ft. per sec., as in Fig. 1. Then will the area of any one large square equal 2 × 7.31 = 14.62 seconds. If a planimeter is used to determine the areas, the value of 1 sq. in. in the "seconds" units may be obtained in the same general way as when a large square on a cross-section sheet is taken as the reference unit.

The area under the .25 per cent. grade curve in Fig. 1, up to

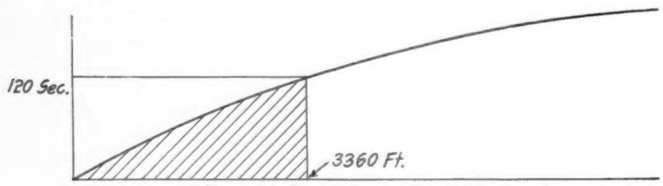
*See *Railway Age Gazette*, August 25, 1911, page 377.

30 m. p. h., gives a time when reduced to the proper units (as explained above) of 120 seconds, and this value is plotted as shown:



Time-Speed Curve for .25% Grade.

Time-Distance Curves (*Fig. 2*).—Remembering that $dS = vdt$, or in general for uniform acceleration $S = vt$, the point corresponding to the space S passed over for $v = 30$ m. p. h. or (44 ft. per sec.) on the .25 per cent grade, may now be determined by reducing the area (to the proper scale) up to 120



Time-Distance Curve for .25% Grade.

sec. on the time-speed curve. It is found to equal 3,360 ft. This is the distance run while accelerating to 30 m. p. h.

sible to attain, and in such case the locomotive will not be hauling to its limiting capacity. A correction may be made in such cases.

Profile Compensated (*Fig. 3*).—The profile of the grade over which the train is to run is plotted on tracing cloth using the same distance scale as was used in the time-distance and speed-distance curves. All the curves in the division must be compensated, that is, the grade reduced at the curve by such an amount that the total train resistance due to grade and curve will not exceed the maximum grade on a tangent. Each degree of curvature has been compensated to an allowance of .035 per cent in grade for each degree of curvature.

Combining Time-Distance and Compensated Profile Curves (*Fig. 3*).—The tracing cloth on which is traced the compensated profile is placed over the distance-time curve in Fig. 2 so that the intersection of the co-ordinates at zero and the start of the grade coincide. The time curve is now drawn as far as the grade remains the same, interpolating between the curves to get the grade required. The tracing cloth is then moved *horizontally* until the end of the curve just drawn falls on the part of the time-distance curve corresponding to the new grade. This final point on the curve will give the total time required to go the entire distance while the time to go any distance from one point to another may readily be obtained from the curve.

Combining Speed-Distance and Profile Curves (*Fig. 3*).—The tracing cloth is again placed so that the intersection of the co-ordinates at zero is made to coincide with the starting point on the profile and the speed-distance curve traced off for the given grade, interpolating between the grade curves drawn

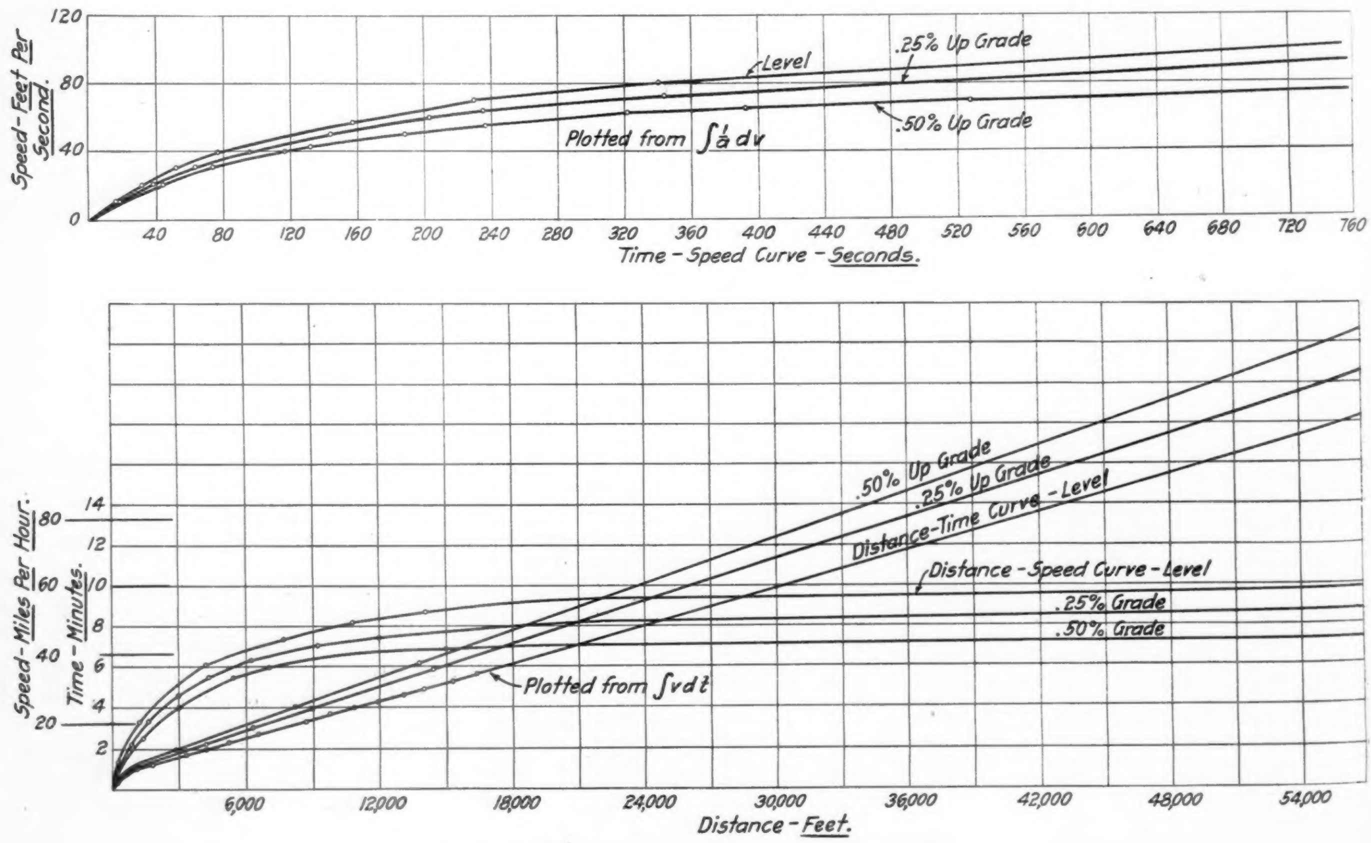


Fig. 2—Speed-Time Curves for the Train Considered

Speed-Distance (*Fig 2*).—The speed-distance curve is drawn from results obtained by above method by plotting velocities as ordinates and distances corresponding to these velocities as abscissas. The accelerating force will continue to act, increasing the speed until the limiting or balancing speed has been reached or nearly reached. However, the controlling speed over a division may not permit of as high a speed as is pos-

in order to approximate to the proper grade curve. This curve is traced as far as that grade remains the same, the tracing cloth is then moved *vertically* until the end of the line traced coincides with the new grade curve and this curve is then traced.

The speed-distance curve will often fall very rapidly and even abruptly due to the fact that a train coming to and ascending a steeper grade than the one on which it has been running

will slow down. It is evident that it will take a certain distance to adjust its speed to the new grade conditions. To determine this distance, we may apply the formula,

$$S = 70 \frac{V_2^2 - V_1^2}{Ft}$$

Where S is the distance run (in feet) to change from higher velocity V_2 (before approaching the steeper grade) to velocity V_1, these velocities being in miles per hour. Ft is the tractive force in pounds per tons obtained from the unbalanced tractive force curve for the grade being considered, and for the average of the two speeds V_2 and V_1.

The results obtained by this method were checked with the actual running schedule of Train No. 21 between Huntingdon and Tyrone. Determined time as found by curves = 35 minutes. Train 21 (similar to train used in above calculations) from time table, 35 minutes.

For the analysis, here discussed, a section of track was chosen in which there are practically no down-grades or level track. The method applies equally well to such cases and also to stopping the train by application of the brakes.

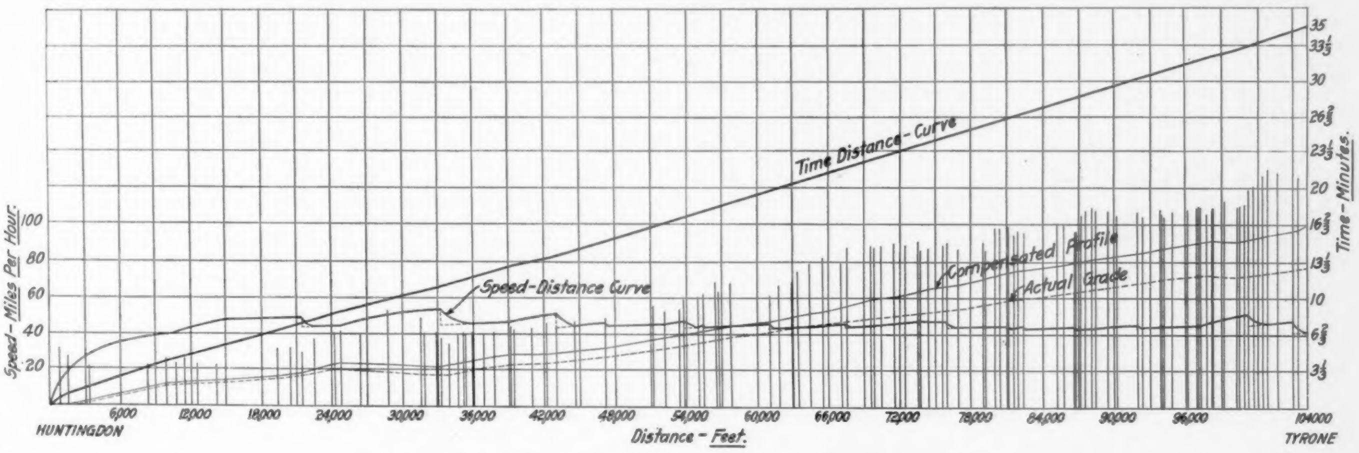


Fig. 3—Speed and Time for Points Between Huntingdon and Tyrone

A FEW FACTS ABOUT LOCOMOTIVE VALVE GEAR

BY HAL R. STAFFORD

No mechanism connected with the modern locomotive has been the subject of so much study, discussion and experiment, and is at the same time so little understood as the valve gear. Only a few years ago we were ready to condemn unheard any type of gear other than the Stephenson. It was generally believed that this was the only one adapted to use on American railroads.

Under pressure of necessity, some intrepid spirits applied the Walschaert gear to one or two experimental locomotives. These applications were made in distinctly American style, with large bearing surfaces, and all members stiff and heavy. The gear was a success from the start, and its obvious advantages, together with the almost absolute necessity of using some type of outside gear on the enormously heavy locomotives of the day, finally broke down the barriers of reserve. After being compelled to listen to reason, we soon became ready to listen to anything on the subject of valve gear; the pendulum swung the other way. Inventors got past the office boy, and were treated with consideration within. Naturally, the feeling was that if we had been backward in trying so good a thing as the Walschaert gear, why not look still farther? A new crop of inventors came up and began to tread the well-worn paths of the thousands who in the past have helped to fill the patent office; old inventions were re-invented and old fallacies re-exploded.

The net result has been that a few good valve gears—mostly old ideas modernized—have found their way into actual service. We may now choose from several practical types, instead of trying to make some change on the old stand-by which would make it accomplish the impossible. Any valve gear which will stand the test of five years or more of service on American roads, and continue to be specified on duplicate orders, undoubtedly has its good points. It can stand on its actual merits without claiming to have all the virtues. There is a tendency to hail every reasonably good new thing as perfect. For instance, the Walschaert was at first claimed by its promoters to give much better steam distribution than its predecessor; actual analysis proved that, with similar lap, travel and lead, one ellipse could be traced almost exactly upon the other. It was also lauded as the engineer's friend because it "handled" so much easier, its advocates, like some of later date, forgetting that what makes a reverse lever hard to move is that you are shifting one or both valves with a given throw of lever, usually about 48 in. It is difficult to get away from the old law about the "power times the distance it moves," but every now and then an inventor claims to have evaded it. Some valve gears handle hard in the corners, and easy when hooked up; with some, as the Stephenson and Walschaert, the resistance is practically constant, provided the gear is free; but the same total work is done during the complete movement.

It will be well remembered how the constant lead of the Walschaert gear was counted as one of its greatest advantages. Now we find well known designers resorting to the subterfuge of greatly increasing the lead in back motion in order to "knock off" the lead in full forward gear, thus imitating, with considerable difficulty, one of the natural peculiarities of the discarded type.

Famous engineers, long since deceased, have told us that there was a difference, in terms of economy, of only about five per cent. between the best and the poorest of the accepted forms of valve gear. One could not have introduced the compound engine, the superheater, the brick arch, or the automatic stoker, upon a five per cent basis; inventors are compelled to speak louder than this to obtain a hearing. So, let us forget steam distribution and economy in urging our pet valve gear upon practical men; let us cease to harp on easy handling and not laud increasing lead or constant lead, but get down to brass tacks.

What has been the cause of the downfall of the so-called foreign gears in their earlier applications? The Joy motion was tried out years ago; the Allan link motion was tried on the Pennsylvania Railroad; the Walschaert was tried many times before it fell into practical hands. These gears did not stand up in service. Bearing surfaces were inadequate and parts were too light, being subject to springing and breakage. Conversely, the points that have given the Walschaert and other modern valve

gears their tremendous hold upon the railroads of today are low maintenance cost, and the faculty of "staying put"; accessibility for inspection and repairs, and simplicity of the mechanism as a whole and of its parts.

Having adopted a form of valve gear well suited to the exacting requirements of modern power, there should be banished, along with the discarded Stephenson gear, certain venerable illusions regarding valve setting. Squaring an engine has always meant equalizing the cut-off in all positions of the reverse lever, often at the expense of port opening at one end. Almost every road has some engine, or class of engines, which sounds lame even when the valve setting report is perfect. An indicator card from one of these would quite frequently show as high as 20 per cent more work in one end of the cylinder than the other, and yet the cut-off is equal; the engine is perfectly square in the accepted sense.

Very few valve gears are so well designed that both lead and cut-off can be equalized at all points of the cut-off. According to regular practice, or following positive instructions, the valve setter unhesitatingly sacrifices the former for the latter.

The rule should be, square the port opening in running cut-off, say 25 per cent cut-off for passenger service and 50 per cent cut-off for freight service, laying the blame for unequal cut-off on the designer, where it properly belongs. A difference of 2 in. in cut-off will usually be much less apparent, both in the sound of the exhaust and in the indicator card, than a difference of 1/32 in. in port opening. The reason for this should be apparent. At the higher speeds and shorter cut-offs, port opening is simply the lead plus a small increment depending on the ratio of lap and lead to valve travel. At 25 per cent cut-off, in modern engines, port opening amounts to from ¼ in. to ⅜ in. At 70 miles an hour, with the valve open this small amount for a period about equal to the snap shot of a very fast camera shutter, it is almost inconceivable how enough steam can enter the cylinder to produce an indicator diagram. Then think of allowing the opening at one end to exceed by 1/16 in. (which may mean 25 per cent) the amount at the other. Cut-off, on the other hand, is usually a purely imaginary point on a high-speed, or even a moderate-speed locomotive indicator diagram; try to locate it, and then let some one else try. The difference between the two estimates will probably greatly exceed an amount equivalent to 2 in. on the stroke.

Steam engine slide valve motion, while it will always require more or less ingenuity in its detailed application, is in principle beautifully simple. Whatever its type, it consists of a mechanism to combine two movements, one at right angles to the other (i. e.), one must cease when the other is at its maximum and to transmit this combined movement to the valve. There are dozens of ways of accomplishing this, most of which have been tried at one time or another. Quick opening and quick closing of the ports has been the goal toward which most inventors have striven, mostly in vain. Slight gains in this respect over "straight" movement, such as the Stephenson and Walschaert, are found in some modern gears, the gain being largely at one end of the travel; but it may be accepted as a truism that any gear accomplishing this desirable feature to any appreciable extent, as measured by the coal pile, will be too expensive and too complicated for this generation, at least.

Many valve gears, highly suitable to certain special types of locomotives, have been condemned in this country because of mistakes in their early applications. Errors have been most frequently made in proportioning parts to the work to be done. Now and then new valve gears have been tried by designers with an adequate knowledge of some peculiarity of the type, as in the first applications of the Walschaert. Those responsible for these earlier designs failed to take into account the fact that, by giving the Walschaert gear a constant lead equal to the lead of the Stephenson at running cut-off, they greatly shortened the full gear cut-off, to the detriment of the starting power of the engine. This lack of starting power was for a long time believed to be an inherent defect of the valve gear, whereas a little less lap would have overcome the difficulty.

By some builders, too much attention has been paid to theoretical considerations in designing the Walschaert gear. For instance, the location of the reverse shaft to give the best equalization of cut-off in both forward and back motion should be in front of the link, with the lifting arm extending backward. If the reach rod is then connected directly to the upper arm, the motion is forward when the block is at the top of the link. This is contrary to good practice, as in case of the failure of the reach rod, or the slipping out of the reverse lever latch, the engine might be suddenly reversed while running at high speed. In this case, as usual, the simplest arrangement is best; locate the reverse shaft convenient to the reach rod, and arrange the gear so that the slip in forward motion is minimized. In road engines, let the back motion take care of itself.

The bogey of box play, which in certain types of radial gear causes a slight distortion of the valve events, has prevented the application (except in a few special cases, where it seems to be giving entire satisfaction) of the well-known Joy motion. The same argument has been used against one of the most successful valve gears of the day. This is but a technicality. It is extremely doubtful if the momentary shortening of the cut-off at one end, compensated for by a corresponding lengthening at the other, has the slightest effect on the consumption of fuel or the drawbar pull of the locomotive.

As mentioned before, the most common error made in introducing valve gears which are used abroad is that we copy European practice in proportioning the parts, along with the idea. It should not be forgotten that American locomotives are expected to run between shoppings, which means from one to three years with only the most cursory repairs, while European locomotives receive much closer attention. Rubbing surfaces, pin bearings, etc., should be nearly double in area as compared with the best European practice, and renewable bushings used in all cases instead of take-up bearings.

POWDERED FUEL

The following is taken from Bulletin No. 8, entitled "Some Engineering Phases of Pittsburgh's Smoke Problem," issued by the University of Pittsburgh:

The main advantages in the use of powdered fuel may be summed up as follows:

1. Complete combustion and total absence of smoke, when this process is carried out in a properly designed and operated furnace.
2. Losses due to excess air and cooling of furnaces by opening of fire doors are reduced to a minimum.
3. Use of a cheaper grade of bituminous coal, as impurities have very little effect on the successful operation of the process.
4. The ability to meet sudden changes in load, and reducing to a minimum the labor inherent to firing.

Among the disadvantages are:

1. Danger inherent to the storage of large quantities of powdered fuel, giving rise in most cities to the enactment of laws prohibiting the storage of large quantities of this fuel.
2. Inability to secure, at a moderate cost, a satisfactory material to withstand the intense heat developed when operating this type of furnace properly.
3. Tendency of the stronger drafts to carry the fuel through the furnace unburned.

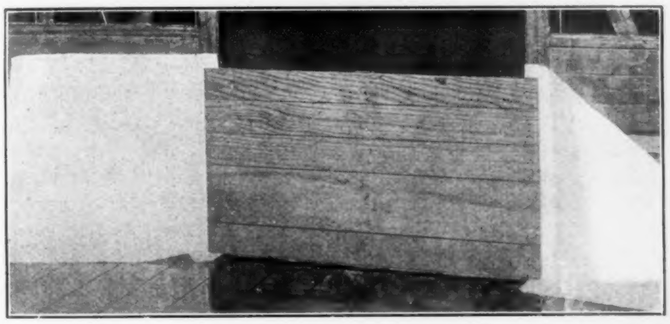
The application of this process to the steam boiler has no doubt largely been hampered by the fact that the maintenance cost in daily operation is high, due to rapid deterioration of brick work. The reliability of all devices as yet applied to boilers, is questionable. It is claimed that savings of 40 per cent have been made when powdered coal was applied to metallurgical processes, such as puddling, heating and reheating furnaces, and that smokeless operation was obtained in all cases.

CAR DEPARTMENT

UNIFORM INSPECTION FOR SPECIAL LOADING

A pamphlet of instructions has recently been issued by the Rock Island Lines covering the uniform inspection and carding of empty box cars, the coopering of cars for grain loading, and the stripping of doors of cars loaded with flour, with a view to having the men well informed and ready to meet the heavy harvest traffic. The pamphlet represents the work of a committee composed of the assistant to the second vice-president as chairman, and other officers who are directly interested in the inspection and handling of cars for special commodities. The following extracts are taken from the pamphlet:

When empty box cars have been repaired, they should be inspected and carded in accordance with the following classification before leaving the repair track:



Method of Applying Grain Doors

The maximum use cannot be obtained from box cars if first-class cars are loaded with commodities which damage the floor or lining, stain or saturate the floor with oil or grease, leave a stench, make unfit for carrying flour, merchandise, etc.; or which could, with safety, be loaded in a car in poorer condition or in a car of a different class.

To reduce to a minimum the difference of opinion between car inspectors, the following rules have been provided, specifically indicating the parts to be examined and conditions required to properly card cars for various classes of lading:

INSTRUCTIONS TO CAR INSPECTORS COVERING EXAMINATION OF EMPTY BOX CARS AND CONDITION REQUIRED TO PROPERLY CARD THEM FOR LOADING FLOUR, CEMENT, GRAIN AND ROUGH FREIGHT.

Parts to be EXAMINED	For FLOUR	For CEMENT	For GRAIN	For ROUGH FREIGHT
Safety appliances.	Must be O. K.	Must be O. K.	Must be O. K.	Must be O. K.
Draft rigging.	Must be O. K.	Must be O. K.	Must be O. K.	Must be O. K.
Posts and braces.	Must be in place and in good condition.	Must be in place and in good condition.	Must be in place and in good condition.	Requires safe running condition.
Siding.	Must not be loose, broken or decayed.	Must not be loose, broken or decayed.	Must not be loose, broken or decayed unless can be coopered.	Requires safe running condition.
Roof.	Must be in first-class condition.	Must be in first-class condition.	Must be good, but not necessarily first-class condition.	Not necessary to be in good condition. Safe to run.
Doors.	Must be in first-class condition.	Must be in first-class condition.	Operative and safe condition.	Safe condition.
Floor and lining.	Must be in good condition, free from protruding nails and from stench, account previously having been loaded with Fertilizer, Hides, Bone, Creosote, Oils, etc. Free from oil stains or saturations.	Must be in good condition.	First-class condition not necessary if coopering will make grain tight. **Do not O. K. for grain if floor is loose at side sills or is oil-soaked.** Must be free from stench, account having been loaded with fertilizer, hides, bones, creosote, etc.	Serviceable condition.
Grain strips.	Good condition not necessary.	Good condition not necessary.	Should be in place or in condition to permit of coopering so as to make grain tight and prevent grain from pressing against siding.	Not necessary.

The following instructions apply to the coopering of box cars after such inspection shows they are O. K. for bulk grain loading, or a higher class lading.

Cleaning.—Sweep the car clean, removing any foreign matter that may be lodged behind the lining.

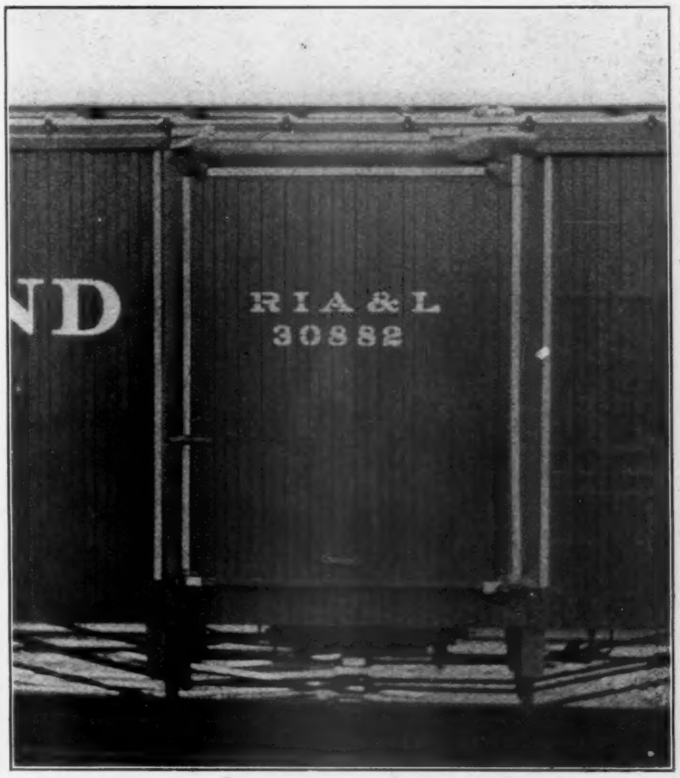
Floors.—Carefully examine the floor for openings through which grain might leak, particularly over the body bolster, around the draft bolts and at the intersection of the floor and the end sills, and at the end, side and door posts. (Most leaks occur over drawbars, at posts over bolsters and at door posts.)

Where openings occur in the floor, cover with cooperage paper; if at the junction of floor with posts and braces, use a pad of paper, securing it in either case by nailing a lath or board over the paper.

Where the floor shows signs of weakness over the body bolster, cover it for the entire width of the car with a piece of 48-in. cooperage paper folded to 24 in. width, securing it with lath and nails at each edge of the paper. If a similar weakness is found over the center sills between the body bolster and the end of the car, cover with paper the same as over the bolster.

Where bolt heads protrude through the floor and it is covered with paper, an additional precaution must be taken to nail a board over them.

Grain Strips.—Where grain strips are defective or not securely fastened to the floor, apply a paper pad extending 5 in. above the floor of the car, inserting it behind the lining and securing it by nailing a lath or strip of wood over it.



Car with Strips Applied for Flour Shipments

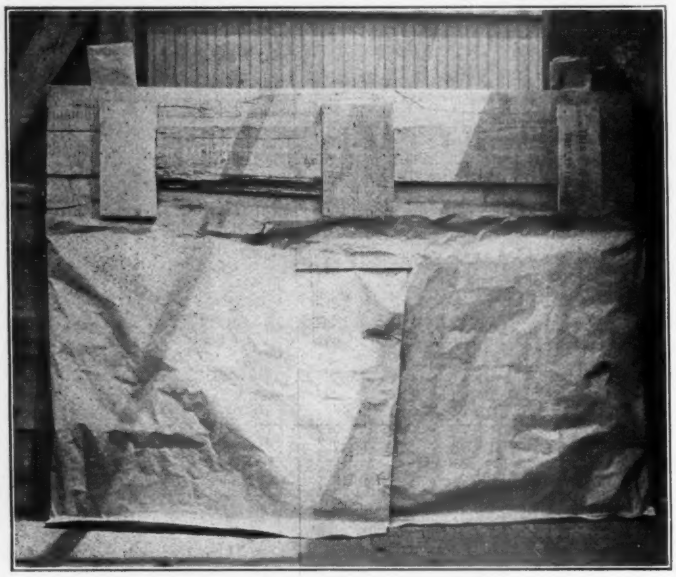
Lining.—Cover any broken or faulty places with cooperage paper over which a piece of board should be nailed. If the size of the defects warrant, cover with paper, over which nail a grain door.

When the lining is in generally poor condition, in addition to the above mentioned coopering, the defective portion should be protected by lining with cooperage paper 48 in. wide, allowing a 6 in. lap on the floor. When applying to the end of the car, begin at the side of the car about 2 ft. from the corner, fit into the corner and extend half way across the end of the car. Apply to the other half of the end of the car in the same man-

ner, letting the ends overlap about a foot where they meet. Secure the paper with lath and nails about 3 in. from the top edge only, using but two 3d shingle nails to a lath. In order that the paper behind the laths may tear at the nails and adjust itself when grain pressure is applied, do not drive the nails up to the head.

Cover end doors with cooperage paper and nail boards over the entire opening.

Grain Doors.—Apply three standard grain doors to each side of the door opening. Fold cooperage paper to four thicknesses, making a pad 4 in. wide on the end of a piece of paper 7 ft. long. Apply this to the inside face of the door post, allowing a few inches' lap on the floor; then place one end of the grain door against this pad. Fold a similar piece of paper for the other door post and apply in like manner. An additional paper pad should be applied to the face of the door posts extending from the top of the pad above mentioned to the top of the grain doors; then nail the grain doors to the door posts, after which fold the loose ends of the paper extending from the door posts, so as to overlap on the inside of the grain doors, and fasten lightly at the top of the paper with lath and nails.



Method of Applying Grain Doors

When applying hardwood grain doors, reinforce only cars of 80,000 lb. capacity or over, by nailing an additional grain door lengthwise over the two lower grain doors on the inside, with its lower edge about 8 in. above the floor. Apply this over cooperage paper.

When applying softwood grain doors, reinforce with two additional grain doors, apply over cooperage paper, placing the lower door about 4 in. from the floor.

Outside Inspection--Siding.—Inspect sides and ends, securely fastening any loose siding with 8d wire nails. Where sills are decayed, prevent leaks at siding by using a pad of paper fastened underneath with a strip of board nailed to the bottom of the sill.

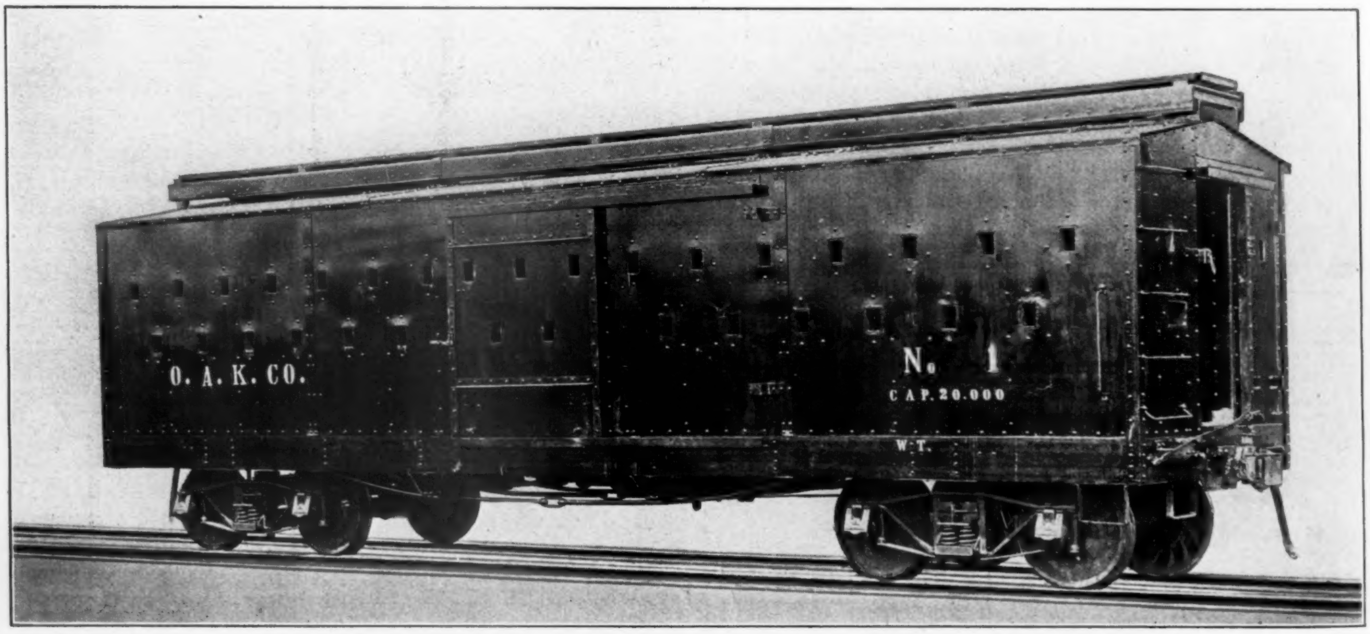
Stripping Cars Loaded with Flour.—To prevent water damage, the side and end doors of cars loaded with flour should be tightly closed by driving a wedge between door and door-guides, after which apply a strip of 11 in. wide odorless tar water-proof paper over the sides and top of the doors, securing it with lath and nails.

ARMORED CARS FOR MEXICO

The car shown in the illustration is one of a number used in Mexico for transporting troops. These cars were originally purchased by the Diaz government in an attempt to put down the Madero revolution. The revolutionists were constantly harassing the federal trains carrying troops and supplies, and it was found necessary to secure some type of bullet proof car.

The cars were built by the Orenstein-Arthur Koppel Company, Koppel, Pa., and are 35 ft. long and 9 ft. wide. The walls and roof are of two thicknesses of heavy steel plate with a 4 in. space between filled with sand and concrete. At the ends and sides square holes are provided, each flared at the outside so that firing can be done in any direction. The floors are steel plates covered with wood and the underframe and trucks are of exceptionally heavy construction. Accommodations for traveling are provided in the way of bunks, water appliances, etc.

The doors are comparatively small and are supported on heavy rollers. They are constructed so that when locked from the inside it is very difficult to force them open and for entering or leaving the car a ladder is provided inside, suspended from the roof by pulleys and ropes.



Armored Box Car Used for Transporting Troops in Mexico

Importance of the Draft Gear Problem

As it Appears to an S. M. P., Master Car Builder, Car Department Foreman and Draft Gear Designer

The following four articles complete the series of twelve which were accepted for publication in connection with the draft gear competition which closed May 15. They are equally as interesting as those which were published in our July and August numbers, presenting, as they do, several unique viewpoints which were not touched upon in the previous articles. The great value of the results of the competition is in the strong expressions which it has drawn forth from the practical men who are face to face with the problem on the firing line and from the engineers and officers in charge of the design and construction—possibly a little farther removed from the actual scene of operations, but none the less interested in giving their best efforts in trying to solve one of the biggest problems confronting the railways today.

THE ESSENTIALS OF A GOOD DRAFT GEAR

BY H. C. MAY
Superintendent Motive Power, Chicago, Indianapolis & Louisville, La Fayette, Ind.

It is safe to assume that 99 per cent of the men who have to do with the car repair end of the railroad business are united in the opinion that one of the prime requisites on any car is a good draft gear, not only because the draft gear is more liable to damage than any other part of the car, but also because a large proportion of other defects found on cars are the result of the use of inefficient draft gear.

Leaky roofs, stuck and damaged doors, leaking brake connections, and damaged ends, are more or less directly traceable to the inability of the draft gear to dissipate or destroy the shocks received by the coupler. The enormity of these shocks is well known, and the damage done by them is better known by the men who maintain and repair cars. Too often the investigation of injuries resultant upon using certain kinds of draft gear stops at the draft gear, and the mere cost of replacing the damaged parts is considered, scarcely any attention being paid to other parts of the car which have suffered damage from the same cause. It is now an established fact that a poor draft gear is a menace to the whole car, and a good draft gear is a protection to the whole car.

The harmful results of using poor draft gear go even further, reaching the domain of the claim agent. Many cases of damaged freight due to shifting of loads would have been prevented by the use of a good draft gear. While the opinion relative to the damage done by the use of poor draft gear, and the advisability of using good draft gear is practically unanimous, some variety of opinion may be found when the question is asked, "What are the essentials of a good draft gear?"

If the term draft gear is taken to mean the whole draft system, evidently the best draft gear is the one in which the capacities of all the parts are balanced each to the other in due proportion to the work they each are called upon to perform. If the term draft gear is taken to mean the spring, or spring and friction unit that is interposed between the coupler and the receiving parts of the car center sills, then the best draft gear will be the one that can dissipate the greatest amount of energy with the least amount of damage to itself, or the car. For want of better name this can be called the draft unit, and the parts used in connection therewith can be called draft attachments.

Whether these draft attachments be lugs or yokes, side castings and yokes, or links and keys, their mission is the same—to transmit whatever forces may be delivered by the coupler through the draft unit to the car sills, and from the car sills to the coupler again. No arrangement of attachments can be made that will diminish any force or forces they are called upon to transmit, and their required capacity and consequent strength will depend entirely upon the draft unit used, as the attachments must be of sufficient capacity to transmit the difference between the absorbing capacity of the draft unit and the total force delivered to the coupler. By this it will be seen that the critical element in any draft gear system is not the attachments, but the draft unit, and it follows as a necessary corollary that the weakest draft unit needs the strongest attachments. The draft unit being the critical point in the draft system its selection should be a matter of greater consideration and closer investigation than the selection or arrangement of attachments. This statement is not intended to minimize the importance of proper attachments, but to emphasize the greater importance of the draft gear unit.

The greater importance of the draft unit being conceded, an examination of its purposes and effects can follow. To repeat what has been stated before in another form, the draft unit is that part of the draft system that is interposed between the coupler and the receiving parts of the car center sills. Its principal characteristic is resiliency and its function is to minimize to the greatest possible degree the injurious effects of sudden and violent shocks applied to the coupler. Broadly speaking, there are two kinds of draft units, spring and frictional, though there are some spring units that claim frictional properties and all friction units employ springs.

The spring unit is too well known to waste words in its description and only requires examination. The spring unit most commonly used consists of two springs, 8 in. in diameter and 7⅞ in. in height, generally known as M. C. B. Class "G." Their combined capacity is 60,000 lb. under a static test and the difference between their free and solid height is 2⅛ in. Several combinations involving their use have been arranged and as a general case, whatever the arrangements, the springs are so applied that a movement of 1¾ in. is secured, thus obtaining the full capacity of the springs. When this 1¾ in. movement is ended the attachments receive the load. It makes no difference what the combination may be, nor how ingenious and powerful the attachments may be, the limit of its capacity as a draft unit is its capacity considered as two springs, which is 60,000 lb.

Sudden and violent shocks that develop an impact force of 300,000 lb. are by no means uncommon in switching service, and according to the rule stated previously, that "the attachments must be of sufficient capacity to transmit the difference between the absorbing capacity of the draft unit and the total force delivered to the coupler," it follows that the attachments must be capable of receiving and transmitting a force of 240,000 lb., which in itself is sufficient to cause much damage to car and loading, even though the attachments may be strong enough to perform their mission. For this reason attachments for spring draft units have been and must be very heavy and strongly secured. The force of 60,000 lb. used in compressing the spring unit, though it has reduced the total force moving in the direction of spring closure, is still alive and operates with destructive effect when the cause of the original shock is removed and normal conditions are restored. The spring unit is but a storehouse for the amount of force used to compress it a given distance, which force is given out when the power causing the compression is removed. This reaction, or recoil, as it is generally termed, continues in a series of actions and reactions diminishing in force with each vibration until the springs reach quiescence.

The result is a succession of quick, snappy blows producing much damage.

The unsatisfactory service rendered by spring draft units led to the invention of units in which frictional resistance, obtained by metallic surfaces rubbing together under pressure of springs, is used to increase capacity. All frictional draft units are based on the fundamental principle of causing all or a part of the energy developed by the force of a blow or movement to dissipate itself by performing work on its way from the coupler to the receiving parts of the car center sills. The amount of work that can be performed in this manner varies with the types of units used, and ranges from 150,000 lb. to 260,000 lb.

Two general types of friction draft units are in common use. In the first type the frictional elements and springs are contained within a cylinder, the walls of the cylinder forming a part of the frictional system. In this type the sequence of events in the operation of the gear is through the spring to the friction elements, and it follows there must be some movement of the spring before the friction elements operate. As wear ensues, due to constant operation, this preliminary movement increases, reducing the efficiency of the gear in proportion to the amount of preliminary spring operation. Objection is frequently made to friction draft units of this type on account of their enclosed form preventing proper inspection and replacement of damaged parts. Through the same feature of their construction, no adjustment to compensate for wear of parts is possible.

In the second type the frictional elements are contained in a divided case, the case occupying the same position relative to the yoke and coupler as the spring unit in a spring gear, or the cylinder in the above mentioned frictional unit system. Springs are used in connection with the frictional elements to obtain the desired results. They are not confined within the case as in the previous type, but are applied and adjusted independently. The sequence of events in the operation of this type of friction unit is the reverse of those belonging to the cylinder type of frictional unit, being through the friction elements to the springs so that there is no preliminary spring action whatever. All the parts liable to damage are exposed and subject to inspection; compensation for wear of parts is readily and easily made, rendering it possible to keep the gear up to its full capacity at all times. The static capacity of draft units of this type ranges from 200,000 lb. to 260,000 lb.

Repeating again the rule that the attachments must be of sufficient capacity to transmit the difference between the absorbing capacity of the draft unit and the total force delivered to the coupler, and assuming again an impact force of 300,000 lb., the attachments must then have a capacity of 40,000 lb. to 100,000 lb. as against a capacity of 240,000 lb. for the spring gear. It must further be kept in mind that whatever force is delivered to the attachments is also delivered to the car and the tendency to disturb anything on the car or in the car is diminished in like proportion.

Whether the injuries to cars are caused by a few violent shocks or by a constant succession of smaller shocks is a question that had been a subject of debate for some time and possibly will continue to be such for some time to come. There is, however, no doubt that damage and costly damage occurs somehow; couplers are broken, yokes are fractured and bent, yoke rivets sheared, roofs strained and distorted, doors jammed and broken, sills bent, rivets sheared, lading shifted with damage to itself and the car superstructure—the greater part, if not all of which damage can be eliminated by the use of a proper draft gear, a draft gear that will dissipate and destroy the shocks instead of transmitting them through the car. No good can possibly be accomplished by making the couplers, yokes, attachments, etc., heavier. That only intensifies the burden.

A car is either an asset or a burden to the company owning it; an asset when it is carrying revenue producing freight; a burden when it is on the repair track. Seventy-five per cent of the repairs on freight cars are made necessary by weak draft gear. A good draft gear is a revenue producer and a burden reducer. "The draft unit is the critical point of the car," and "the essential part of a good draft gear."

REPAIR TRACK MILEAGE DOES NOT PAY DIVIDENDS

BY F. H. SWERINGEN

Master Car Builder, Streets Western Stable-Car Line, Chicago

There is no question but that cars can be built strong enough to carry the load according to the stenciled capacity, but cars do not fail to any extent from the vertical load; if placed under load on a storage track the physical condition of the car would remain the same for an indefinite period of time. But cars are failing and bad-order cars are increasing in abnormal numbers. The nature of the failures leaves no room for doubt as to the cause.

Through the introduction of gravity yards and Mallet locomotives; congested terminals, making it necessary to switch cars at a high rate of speed, and more powerful switch engines, conditions never before experienced in the history of railroading have been brought about. These conditions have paved the way for enormous shocks due to pulling, buffing and recoil. These shocks and the fact that the cars are largely equipped with spring draft gear, affording very little protection to the car, are responsible for the abnormal increase in the number of bad-order cars; the cars are being pounded almost into a state of destruction.

The following list of failures, which are found to exist on cars all over the country, verifies the foregoing statement: Broken draft spring followers, follower stops, coupler yokes and rivets, draft timbers and bolts, end sills, dead-woods, couplers and their attachments, bent draft sills, loads shifting through the end of the car, roofs shifting, siding raked, and other defects resulting from shock where the spring draft gear fails to do its duty. Should this statement be doubted one visit to any of the various repair tracks and scrap piles or the checking up of the repair bills for any one month will verify it.

Special analysis of repair bills reveals the fact that 75 per cent of the repairs to freight cars is due to draft gear failures. In making this analysis no account was taken of shifting loads; ends bursted out; and roofs, running boards and siding raked. The spring draft gear, being responsible for 75 per cent of the total failures to the car to which it is attached, conclusively demonstrates the weakest spot and the one needing immediate attention in order to reduce the abnormal number of bad-order cars, thus keeping the cars in service and making them participate in paying dividends to the owner.

Capacity is one of the things most desired in railroad equipment. The capacity of a car has been doubled within the last ten years, consequently each part of the entire structure affected by the increased load should be strengthened accordingly. The selection of the draft gear and the manner of its application are of vital importance. The draft gear that fails to develop a high capacity with a minimum amount of recoil spells destruction for the car and reduces the dividends according to the failures for which it is responsible. For many years high capacity draft gears have been in course of development. The draft gear manufacturer has spared neither time nor expense in placing on the market friction draft gears that develop a high absorbing capacity, and which will, if used, destroy the effects of the majority of shocks. Through the use of the spring draft gear the effects of the shocks are not destroyed.

Many of the leading railroads and private car companies are now using friction draft gear on both new and old equipment. In doing so they find that they have greatly reduced the maintenance cost of their equipment as well as loss and damage to lading. Quoting F. F. Gaines, superintendent motive power of

the Central of Georgia, in the April, 1913, issue of the Railway Age Gazette, Mechanical Edition: "In rebuilding wooden coal cars, metal draft arms, engaging the steel body bolster so as to re-enforce the center sills at this point, were applied in connection with a substantial friction draft gear. These cars have been in service about three years without any cost for repairs to couplers or draft gears." The results obtained by Mr. Gaines can be accomplished by any railroad company adopting a high grade friction draft gear.

The mechanical department furnishes the operating department with equipment in condition to handle the business at a minimum maintenance cost and with the least delay. So far as the other departments are concerned the mechanical department is the sole owner of the car, being responsible for its condition at all times. When the car fails, account of bad-order, it is not the general manager that gets the "jacking" up, but the mechanical officer. Consequently it is of vital importance for him to equip the cars with the best device which will keep them in service. Every cent spent in repairs to cars must be taken from the earnings of the company, thus reducing the dividends accordingly. The mechanical department does not participate in creating a revenue in any form other than through the economical management of its department.

We find that the majority of car failures are due to the inefficient draft gear. In order to increase the dividends, reduce repair track mileage and keep the cars in service, use a friction draft gear that will protect the car against the element of shock which is responsible for its defective condition.

Which is the most efficient draft gear in use? The most efficient draft gear is the one that has the least amount of recoil, will not shear rivets, prevents deflection of center sills and is constructed as nearly mechanically correct as it is possible to build it. To comply with these requirements it should be so constructed that the car inspector can inspect all parts at any and all times in the same way as he inspects the remainder of the car. This is impossible if the working parts are confined within the walls of a barrel or casement; in event of failure of either springs or friction elements the gear is liable to remain in that condition until the car is placed on the repair track for general repairs. If the draft gear had not failed it might not have been necessary to place it on the repair track for general overhauling.

The spring is the foundation of any draft gear, either spring or friction. If the location of the spring is such that it can be removed at any time that it may fail, without disturbing any other part of the gear, or taking the car out of service; in other words, being able to replace it as easily as to replace an air hose or an injured bearing, the gear must then be mechanically correct in this respect, as with this construction it guarantees the keeping of the draft gear up to its highest state of efficiency at all times. There is only one friction draft gear, to my knowledge, that contains this feature.

All draft gears develop slack if they do any work. The only method of taking up slack on most draft gears is through the introduction of slack followers. The coupler travel is reduced according to the thickness of the follower used and in consequence the capacity of the gear is also reduced. The longer the coupler travel the greater the capacity of the gear. When the horn of the coupler engages the striking plate the draft gear is at rest; the coupler horn becomes the draft gear and the car receives the shock. There is a friction draft gear so designed that it affords an adjustment which provides for the taking up of the slack, and through this adjustment the original coupler travel is always maintained, compelling the draft gear to do the work it is intended to do throughout the life of the car.

Most of all other devices used in car construction, such as brake beams, couplers, knuckles and knuckle pins, are submitted to a physical test before purchase; yet the draft gear, the most important device, is purchased without being tested. Some of the leading draft gear manufacturers have placed at the disposal of the railroad man laboratories equipped with devices for the testing of the draft gear. The same information can be obtained by testing the draft gear that is obtained by testing all other parts mentioned above.

Summing up, in selecting a draft gear the one which should be used is the one which will dissipate the greatest shock, develop the least amount of recoil, and yet be mechanically constructed to protect itself as well as the car, thereby reducing the repair track mileage to a minimum and increasing the dividends by keeping the car at work.

THE DRAFT GEAR PROBLEM

BY WILLIAM SCHMALZIND
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At the time the automatic coupler was introduced to replace the link and pin method of coupling cars, a single spring of 19,000 lb. capacity was placed back of the coupler to act as a cushion for any blow or shock received. There were cases also where two springs were used. The cars were of wood construction of light capacity and were handled in trains of short length. The locomotives had a tractive effort of about 12,000 lb. As the demand for longer trains and larger cars became greater it was found that the cushion offered by this light draft spring was insufficient and it was necessary to increase the capacity to 30,000 lb. As far as cushioning the blow was concerned, the increase in capacity was thought sufficient, but there was another feature that had to be taken care of, and that was the recoil. This caused the train to part because of the failure of the coupler to stand the quick snap.

With this great barrier confronting the progress towards longer and heavier trains, it was necessary to design a device that would have a higher capacity than was possible with springs alone and have little or no recoil. The friction draft gear was introduced. This was twenty-six years ago. Is it not apparent that proper attention has not been given to the draft gear, since we have cars of 100,000 lb. capacity in service which are equipped with the spring draft rigging of twenty-five years ago?

There are certain items on a car that are expected to be renewed, such as wheels, brake shoes, axles, journal bearings, air brakes, paint and lubrication. But in addition money must be spent for damage to the car. There may have been required a new coupler, a new end, a new draft sill or end sill, aside from claims paid for the destruction or damage of valuable lading that the car contained. When we consider the nature of these damages, we come to the conclusion that the car was struck by another car in switching, or was subjected to a shock in train service that the draft gear was not capable of absorbing. Let us assume that the car when new cost in the neighborhood of $1,000. This $1,000 was to be protected or insured by the device placed back of the coupler to take care of the blows or shocks. Suppose it consisted of a pair of springs of 30,000 lb. capacity and cost a few dollars less than the best insurance obtainable; would it not have been a saving to have spent a few dollars more and have the best for a longer time and prolong the earning capacity of the car by keeping it off the repair track?

We know that in actual train service, blows or shocks have been registered as high as five and six hundred thousand pounds. A device of fifty thousand pounds capacity will take care only of fifty thousand pounds, and the remainder of the shock goes to the car, does the damage above mentioned, and puts the car in for repairs and stops its earning capacity. Money is lost in repairs and idleness for money saved on the first cost of a device that was not worth what was paid for it.

Cars are being constructed today of steel, and many with steel underframes, in order that they may better withstand hard service than a car of all-wood. Is it not advisable to

have the best possible device to take care of the shocks that the wooden car absorbed to a certain extent in the elasticity of its bolts and timbers?

The time is rapidly approaching when the wooden car will have passed out of existence and we will have trains made up of all-steel cars. When that time comes, what is going to be called upon to destroy the shock and protect the steel car and its lading, or both? The shock must be absorbed rather than stored up and returned in the form of recoil.

A non-recoil friction draft gear is the only solution. In selecting a draft gear, the construction should be considered first; second, the capacity, and third, the time limit of its action. The latter is a very important factor. There are different types of friction draft gear on the market, having high capacity, but the travel, or time limit of action, is so small that the capacity is of no advantage because of the fact that the gear is too stiff, or, in other words, the blow has not time enough to be absorbed in friction.

There is another advantage to be gained by the use of a first class friction draft gear, and that is the time saved in inspection in interchange. Time saved in delay to traffic is money saved, and as the inspector goes along from car to car inspecting the equipment, it is quite to his advantage if the inspection can be made easily and with despatch. A draft gear that can be seen without question of its being in good working order or not, is a great advantage. There are draft gears that are so contained between the sills of a car that it is just about impossible to know whether they are intact and doing the work or not. A car may be equipped with such a device and the device may be out of commission as far as its protective merits are concerned, and still be passed by the inspector time and again. The car will continue in service until it becomes necessary to hold it, remove the parts incasing the gear, and find the trouble.

The necessity of taking up slack in a draft gear is also of importance, as the parts will wear.

It is practically impossible to know what the shocks amount to until we see the damage done to a car that was designed to take a great shock in itself without the consideration of draft gear protection, so to speak. While the car may be of all-steel, it will not absolutely take care of, or pass off, a great shock or a continuance of shocks without being distorted or failing at some point in its make-up. There are parts of cars being damaged today, due to shocks, that people do not attribute to the inadequacy of the draft gear, as long as the draft gear is not damaged to a point of uselessness.

It is quite reasonable to believe that if the coupler does not have something behind it to take the shocks it will eventually be damaged. Then again, if the coupler is increased in size and weight it will mean the constant failing of some weaker part of the car in turn, making an endless chain of failures. Most everyone will agree that with the best friction draft gear, of the longest possible travel and highest capacity, we could cut in half the amount of money and grief we are spending on couplers.

This particular assertion calls to mind the fact that at one railroad terminal alone an average of 300 couplers a month are replaced. This is only one terminal among hundreds that are using the same number or perhaps more.

Some people are of the opinion that a test of draft gear at a laboratory, or other than an actual service test, is not a proof of merit. We will agree that a laboratory test is not a service test, but it is getting somewhere near to what you want to find out, and as far as the comparison of the devices is concerned, we will at least know if they will stand up in a less severe service than actual train service. Couplers, knuckles, knuckle pins, brake-beams, etc., are tested to do a certain work before being purchased, but the draft gear that is to protect these parts receives the least consideration.

FRICTION DRAFT GEAR*

BY GEORGE L. HARVEY
Mechanical Engineer, Chicago

First see that the car is properly equipped to hold the friction draft gear, and to stand the stresses of modern service. The drawbar should be a heavy steel bar with a 5 in. x 7 in. shank, and the bar should have 1¼ in. clearance sidewise and ¾ in. top clearance. If a flat carrier iron is used, not less than 1 in. x 3½ in., there should be two 1¼ in. and two ⅞ in. bolts, one of each on each side of the bar. The downward hammer blow is quite heavy, and many gears are improperly equipped in this respect. The malleable iron type of carrier iron is very good, with a horizontal 1¼ in. bolt passing through it, thus using one bolt for the carrier iron and putting it in shear. In addition it ties the draft arms at this point.

The deadwood should be of cast steel, and it is all-important that the horn of the coupler should not strike it. The full strain of the buffing should come through the draft gear, and be partially absorbed by it and partially transmitted through the center sills. The horn of the coupler should be ⅜ in. from the deadwood when the gear is closed. A friction gear that will not stand these full shocks of service is not suitable for the purpose for which it is intended.

ULTIMATE STRENGTH OF DRAFT GEAR

I consider 600,000 lb. as the load on which to base the calculations for draft gear stresses. Sometimes they exceed this, but rarely, and the factor of safety provided in the size of center sills will generally take care of any higher loads than this. A friction gear should be able to carry a static load of 600,000 lb. without injury. Some advocate a gear which closes at 150,000 or 200,000 lb., with the idea that any additional strain will pass through the horn of the coupler and the center sills, and claim that a static test of 600,000 lb. on the gear is an unfair requirement. Let the friction gear take the blow! It is better to smash the draft gear than the car.

In making a test with 600,000 lb. loads on draft gears they should be measured carefully before they are put in the testing machine. Measure the height on both sides of the gear, also the diameter of the barrels, and after the test take the measurements again. The friction spring gear (Harvey) is made of tough tempered steel, and when the spring is closed 600,000 lb. or more can be placed on it without injury. When the spring is closed at, say, 180,000 to 225,000 lb., there is no more strain thrown on the friction member, as the inner main coil is closed solid, and none of the excess load above the closing load is thrown on the outer friction spring coil member.

Ultimate Strength Tests.—These tests were made to show the ultimate strength of several different kinds of draft gear, the tests being made by Prof. Gebhardt, of the Armour Institute. All the gears were submitted to loads of 600,000 lb. in the static testing machine, and the results obtained were as follows:

Gear	Set	Spread	Remarks
A........	7/16 in.	1/16 in.	....
B........	3/16 in.	⅛ in.	....
C........	0 in.	0 in.	Perfect condition
D........	½ in.	....	Barrel cracked 5 in.

Eccentric Loads.—The 60,000 lb. laboratory test is fair, in a way, but it does not take care of eccentric loading. When the cars are bumped together the gears do not close square, but almost always eccentrically. When two couplers come together they kick sidewise 1¼ in., and the butt of the coupler may be thrown off the center line about ¾ in., so that it strikes the front stop. It is evident that the drawbar itself will thus be thrown 2 in. out of line when the cars are coupled. This will

*Mr. Harvey is the designer of the Harvey friction spring draft gear and prepared a most excellent and voluminous contribution to the draft gear competition. In editing it to come within the limits of the space available for its presentation, certain portions referring more particularly to the special claims for this particular gear and the design and construction of its details, have been cut out or condensed. Names have been omitted where a direct comparison is made with other gears. In fairness to Mr. Harvey it should be remembered, therefore, that the article as it appears is little more than an abstract of the original paper.

twist the front follower and throw an eccentric load on the gear. It would probably be more proper to test all gears with an eccentric load, using a bevel plate, beveled say 1/4 in. in one foot. This would then give a static load on the gear somewhat similar to that which is found in service. The great difficulty with all laboratory tests is to make them resemble service conditions.

The rear draft lugs should be made longer than the standard MCB lug. There is no reason why they should not be made 50 per cent longer, with a butt plate behind the lug, running to the bolster.

The sills should be prevented from spreading with a substantial tie strap, say 3/4 in. x 6 in., with two 7/8 in. bolts at each end. The tie straps should be hooked up over the sills, and for long gears two straps should be used. Many tie straps are bent downward to pass under the yoke, but this is not a good practice, as the straps tend to straighten out.

Center Sill Area.—Center sills on steel cars should have not less than 26 sq. in. of metal in cross section; the area of both center sills and the cover plate is included in this figure. Charles Lindstrom, chief engineer of the Pressed Steel Car Company, has for years advocated designing steel cars so that the center sills would stand a compression of 500,000 lb. From this he determines that the area of the center sills should be 23 sq. in. in order successfully to stand the working strains of train service. Center sills so designed will, of course, stand a much higher load before failure.

The center line of draft should be placed about 2 in. or 3 in. above the bottom of the center sills. If steel draft arms are used, the metal should be about 9/16 in. thick and a splice made back of the bolster, although some prefer to splice the sills in front of the bolster, as in case of a breakdown they assume there would be less damage to the bolsters. Filler plates can be put in back of these splices, running to the bolster, in order to stiffen the gear and the bottom edge of the center sills should be covered with a plate from a point just back of the rear draft lugs back to the bolster.

Follower Support.—All gears should have the followers supported on guides. This will cause the yoke to hang down on top of the followers, and be free at the bottom edge of the follower. If the yoke is supported, and the followers lie on it with the gear, there is a clearance at the top of the followers. When you pull on a draft gear, and the drawbar is raised up at the same time, if there is no clearance at the bottom of the followers, there is a tendency for the yoke to pull off the head of the drawbar rivets, which is not the case when the ends of the followers are supported on guides. If a bent plate is used for lower guide and tie strap, care should be taken that there is ample side clearance. All nuts should be secured with grip nuts.

Many people think that if a gear shows well on a wooden car it is satisfactory for a steel car. Such an inference is far from correct. In wooden cars the sills and the whole car structure yield and absorb a large part of the blow, whereas the steel car is so rigid that the gear which might answer the purpose on a wooden car would certainly not stand up satisfactorily.

THE IMPORTANCE OF FRICTION DRAFT GEAR

J. C. Fritts, master car builder of the Delaware, Lackawanna & Western, presented a very good paper on "Freight Car Troubles" at the Central Railroad Club meeting in September, 1913. He was frank to admit that he had not realized the importance of the draft gear problem, and said: "I am free to confess that up to the time I started to investigate this question some time ago I did not credit it (friction draft gear) as being such an important factor in the question of car maintenance and other expenses incidental to car failures."

The data compiled by Mr. Fritts is unusually interesting. Among other things he said: "In an examination of 1,500 cars equipped with spring gears, and 4,805 cars equipped with friction gears, the number of failures of couplers, pockets, rivets, followers and other parts was 64 per cent. less in favor of cars equipped with friction devices." This is a pretty broad statement. He examined a sufficient number of cars with sufficient detail to obtain a fair idea of the proposition. Any one that will read that article and say that the friction draft gear is not essential for the proper operation of a railroad is certainly making a great mistake.

Some people think it is far-fetched to charge roof repairs as due to draft gear troubles; some do not. There are many repairs required on cars that are due to draft gear weakness that are not charged to it. The enormous amount of repairs required on draft rigging almost staggers one. One road required last year 108,000 pieces of center sills, and 148,000 oak draft arms. The cost of this material alone is a stupendous figure, but when you take into account the other damages to the car and the cost of putting the sills on the cars and the delays to service, etc., you can imagine what the expenses to this road have been, due to ineffective draft rigging.

The question of the amount of repairs occasioned by the draft gear is difficult to determine. F. F. Gaines, superintendent motive power of the Central of Georgia, in his article on "The Growing Cost of Freight Car Repairs" in the American Engineer shows that all items connected with coupler and draft gear covered 38.91 per cent of the total repairs on the cars repaired by the Central of Georgia during six months. M. K. Barnum is authority for the statement that the damage to the draft gear alone is about 18 per cent. Figures have been given as high as 54 per cent to 68 per cent. One large system found the cost of draft gear repairs was 53 per cent of the total.

You will notice Mr. Gaines does not include any damages to center or end sills as a part of his draft gear troubles. Therefore, I consider his figure as being too low. Suppose 45 per cent was the proper figure; just look over your repair bills for last year, and see what this means in dollars and cents.

REQUISITES OF A FRICTION DRAFT GEAR

What are the requisites of a good friction draft gear? It should have a small number of parts. Some friction gears have 2; some 34. It should be possible to readily inspect the gears. Closed gears often run with broken parts, which cannot be examined unless the gear is taken off the car at a considerable expense.

A gear should weigh as little as possible. Some friction gears weigh 110 lb. per car; many weigh 300 to 350 lb., and some 700 or 800 lb. per car. A draft gear with very high capacity and an initial high capacity is of no value. C. A. Seley, before the Western Railroad Club, stated: "The thing that wears out the cars is the multiplicity of small shocks—thousands of them—and a gear to take up these is far more desirable than one to take up maximum shocks that occur once a day, once a week, or whenever you please."

When a train is running under full headway there are small shocks which should be provided for. The drawbar pull may run from 8,000 to 14,000 lb., and you will notice little shocks occurring once or twice a second, working the platforms of the car forward and backward. This motion should be taken up on a spring gear. It is a comparatively delicate shock, and will wear out a friction gear rapidly in case the gear is so designed that it is essential for the friction parts to move in order to take care of this vibration. A primary free spring motion is essential in order to take care of the light shocks and save the wear on the friction parts, which should only be brought into play for the heavier loads.

The friction gears should have a capacity of 160,000 lb. when new, and at the end of a few weeks should carry more than that, as by that time the parts will have a chance to wear to a proper bearing surface. At the end of two or three years they should have their original capacity, at least. Some gears wear themselves out in two or three years.

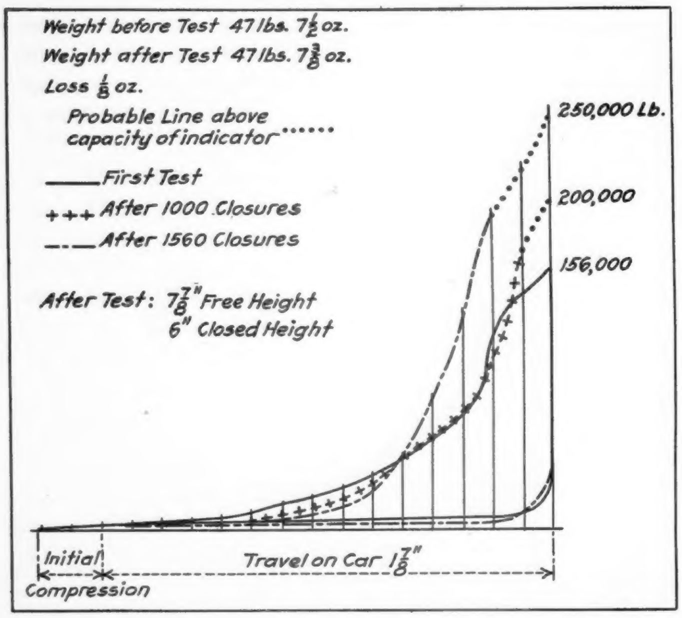
A duration test may be made by any railroad having a good sized bulldozer. The friction gear is put in the bulldozer, and opened and closed a number of times to determine how many

closures it will make before wearing out. The gear is weighed before being put in the machine, and is then opened and closed, say 500 times; then reweighed and examined, and then put in again, and the test run to the number of strokes considered necessary. It is well to put a large timber back of the gear to protect the bulldozer from damage at the time the gear goes solid. It is necessary to stop the test every little while, so that the gear may be allowed to cool and not become too hot. Following are the results for several gears tested in this way by Prof. Gebhardt, of Armour Institute:

Gear	No. of movements	Action of gear	Condition of gear	Loss of weight at end of test	Remarks
A	2011	Smooth	Good	2 lb. 1¾ oz.	1½ in. lost motion.
B	1750	Very irregular	Broke, test stopped	1 lb. 6⅜ oz.	During test several parts were removed because of breaking.
C	982	Very irregular	Broke, test stopped	2 lb. 3⅞ oz.	1⅜ in. lost motion.
D	After 400 to 500 movements the gear was out of service.				Friction parts worn out before 500 movements.
E	2500	Capacity increased		0 lb. 3 2/10 oz.	No set.

Partial results of an endurance test of the Harvey friction spring gear are shown in the diagram.

A friction gear should not stick. If it does there is no shock absorber for the next shock, and the gear will run with slack,



Endurance Test of Harvey 8 In. by 8 In. Friction Spring Draft Gear

and if it remains in that condition the entire rigging may be destroyed at the next heavy blow.

The area of friction should be large. It has been found in duration tests that gears with small friction areas wear out more rapidly than those with large friction areas. Some gears have as low as 64 sq. in. of friction area, while some have over 120 sq in.

I know of a road which has had 40,000 gears with no expense for maintenance in three years. Another road has over 20,000 gears, with an expense of maintenance of .021 of one cent per gear per annum.

I have seen reports of roads where the cost for maintaining another friction gear was 13 cents per gear; another 20 cents per gear for a period of nine years and three months on 5,800 cars. The cost in this case does not take into account the cost of couplers, center sills, end sills, etc., etc., but these figures alone are worthy of considerable investigation.

It is essential that draft gears should have a low release, running from 12,000 to 20,000 lb. A high release means damage to the cars. I know of a train of 74 steel cars, where three couplers were broken, due to recoil, after the train had come to rest and the air brakes were released.

One road thought it was doing a fine thing when it used a gear with a closing capacity of 500,000 or 600,000 lb. It was said that the horn of the coupler showed practically no marks on the end sills; after trying many thousands of these gears, it is now discarding them as the gear had a very high recoil—too great for the car to stand and the draft gears went to pieces.

It is rather difficult to determine just how one is to find out what the best gear is for the purpose from laboratory tests, as they are unable to reproduce the service conditions.

Many roads pass on the value of the draft gear by the static test card, thinking that the gear with the largest area of card will show the best results in service. This theory one would naturally think would be correct, but it is not. My explanation is simply this, that the gears do not develop the same characteristics when struck a quick pile driver blow, or a blow in train, as they do on the static testing machine.

In comparing a series of drop tests with those on a static testing machine it was found that the gear with the smallest area of card was the greatest shock absorber, while the gear with the largest static card gave the poorest results. There is no laboratory test that can give you the information of service tests. You may find a gear that will stand up under certain laboratory tests, and will prove absolutely inadequate in service. There is no test like train service and no drop test like the test of dropping trains on trains.

DRAFT GEAR RESULTS

The Railway Age Gazette, in its request for an article on draft gears, stated: "The judges will base their decision on facts and evidence presented to show which types of draft gear are giving the best results." It evidently meant the best results in service and not in the laboratory tests.

Let us assume that the average cost of repairs on a freight car is $60 per year, and that 45 per cent of the repairs is chargeable to draft gears. The draft gear cost for maintenance would then be $27 per year. Mr. Fritts showed that friction gears will save 64 per cent of the draft gear troubles. In other words, by using a good friction gear you could save 64 per cent of this $27, or $17.28. How long will it take to pay for a friction draft gear at this rate?

SOME NOTES ON CHILLED CAST IRON WHEELS*

BY E. B. TILT
Engineer of Tests, Canadian Pacific

In the following notes on the use of chilled cast iron in car wheels all questions of design, including flange and plate thickness, as well as weight, have been disregarded, and only the metallurgical problems of how to make white iron harder or more resistant to wear, and how to make the combination of white and gray iron in the flange stronger and tougher, have been considered.

Fig. 1 shows a new 675 lb. M. C. B. 1909 design wheel, in accordance with the specification with reference to chill. The M. C. B. specifications prescribe a method of selecting wheels for test, which are drop-tested for strength and thermal-tested (1½-in. ring of fluid iron poured around the tread) to show their capacity to resist the heating action of the brakes.

Fig. 2 shows a flange which has been knocked off with a hammer to show the direction of break. This is one of the greatest sources of danger in the cast-iron wheel, though a seam at the throat very often precedes failure. Fig. 3 shows a typical failure due to over-heating by the brakes.

"Brake burns" and "shell outs" are minor defects, but to increase the service of the wheels they should generally be a minimum. It is not known whether metal which shells out or brake-burns easily is dirty or has more impurities than a metal

*Abstract of a paper presented before the American Society for Testing Materials, at the seventeenth annual meeting, June 30 to July 3, 1914.

which does not. It is hoped to get some connection between this trouble and the different coefficients of expansion of the compounds forming the metal.

There is at present some disagreement among authorities on chilled cast iron as to the best mixtures. Some contend that charcoal iron of chilling quality is necessary; others that steel

Fig. 1—Tread Section of a 1909 M. C. B. 675 Lb. Wheel

scrap and ferro-manganese serve the same purpose. A representative mixture of each is approximately as follows:

CHARCOAL IRON MIXTURE

Charcoal pig iron	70 per cent
Scrap wheels	30 per cent

STEEL SCRAP MIXTURE

Coke pig iron	45 per cent
Old wheels	45 per cent
Malleable scrap	5 per cent
Steel	5 per cent

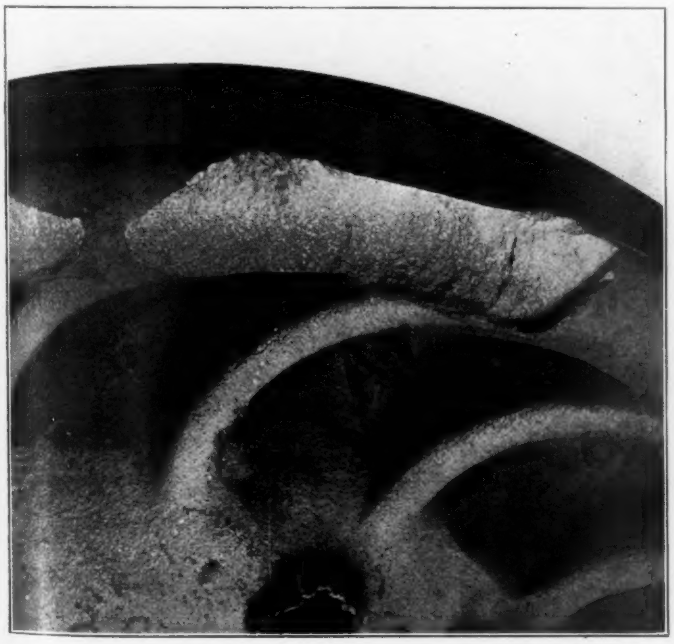


Fig. 2—Flange Broken with Hammer, Showing Direction of Fracture

Wheels made of each mixture meet the specifications. In the author's opinion service results depend on the final composition, and care of manufacture and inspection. Direct comparisons are difficult to make on account of different methods of keeping records; and comparisons of wheels made now of coke iron with wheels made years ago of charcoal iron are difficult on account of changes in the service conditions. A representative analysis of present-day wheel iron, using coke pig iron and steel, is as follows:

Total carbon	3.60 per cent
Silicon	0.60 per cent
Manganese	0.50 per cent
Phosphorus	0.30 per cent
Sulphur	0.12 per cent
Iron	remainder

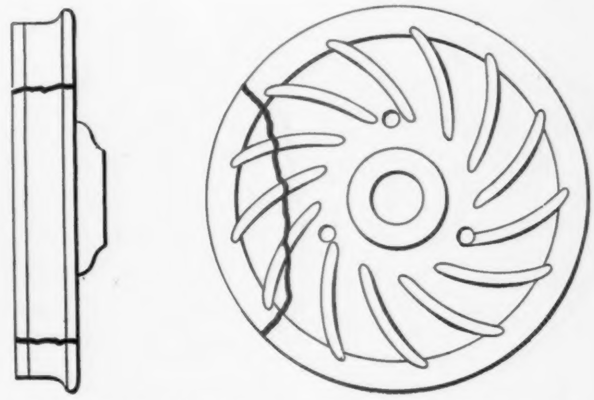


Fig. 3—Typical Failure Due to Overheating by Brakes

The best proportions of the metalloids and their compounds, and the compounds of silicon and manganese are not definitely settled. Nickel, chromium, vanadium, titanium, and other metals have been used with results not always exactly determined. It is the author's opinion, to be confirmed by further experiment, that the amount of total carbon should be low, say about 3.40 to 3.60 per cent, rather than about 4 per cent, as with many white irons. The silicon content will generally be somewhat higher than the manganese, but both in the neighborhood of 0.60 per cent. Good wheels are made with sulphur as high as 0.17 per cent and phosphorus 0.50 per cent.

An examination of Fig. 1 shows the flange to be white iron in part, and Fig. 2 shows the broken flange continued down through the gray iron, which is the usual direction of breaking. Fig. 4 shows stress-deformation curves for gray irons from the

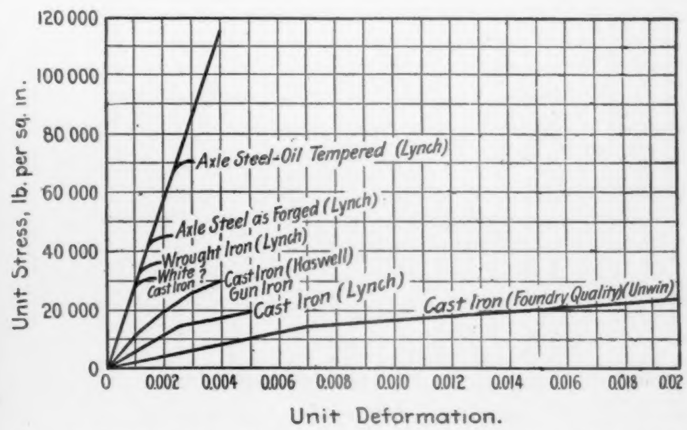


Fig. 4—Stress-Deformation Curves for the Common Steels and Cast Iron

sources noted, and for comparison the curve for the common steels is included. A curve for white iron is shown where it is thought it might be found. It is evident that the flange strength is dependent upon two substances. The first is the white iron which carries almost all the load until rupture takes place in it, when the gray-iron back takes the load; and it is evident that if both could be of the same elastic ratio an improvement would be made. A possible solution is to have as much white iron as can possibly be allowed, and also to have the gray iron as

hard as is possible without its being too brittle in the plates.

In order to see whether the strength of white iron varied appreciably in our regular practice, it was decided to test chilled circular rolls, 2 in. in diameter, and partly chilled rectangular bars 1½ by 2½ in., similar in structure to the flange of a wheel. Fig. 5 shows the ends of two rolls, also a regular wheel

Table I.—Height of Drop to Break Bars of Widely Different Mixtures

Quality of Iron	Silicon, per cent	Combined Carbon, per cent (estimated)	How Cast	Chill	Height of Drop to Break, in.
Wheel iron......	0.68	3.50	Chiller	Completely	15
Wheel iron......	0.68	1.00	Green sand	None	27
Cylinder	1.27	....	Chiller	Around edge	14
Cylinder	1.27	0.90	Green sand	None	21
Machinery	1.60	....	Chiller	Mottled throughout	10
Machinery	1.60	0.60	Green sand	None	18

foundry chill block taken to show the amount of chill at each tap, and of one of the partially chilled test bars. These bars were drop-tested on 10 in. supports with a tup of 42.3 lb., caught on the rebound. The drop was started at 8 in. and increased 1 in. at a time until the bar failed. The difference in height of the drop to break bars of widely different mixtures, in chills and in green sand, is given in Table I.

An interesting point is that when the wheel-iron bars are annealed in the pits with the wheels (a period of 4 days), the average height of drop decreases from 15 to 12 in. This would

Table II.—Drop Tests on Half-Chilled Bars

	Depth of Chill, in.	Height of Drop to Break, in.
Maximum....................................	1.30 0.95	18 18
Minimum....................................	1.05 0.60	12 12
Average....................................	1.20 0.75	13.5 14

suggest that unannealed flanges are the strongest. When the unannealed bars are heated to 500 deg. F. and tested at that temperature, the average height of drop is increased from 15 to 20 in. This suggests less liability to strip flanges by blows under heavy brake service.

Records were kept for a number of months' operation of the wheel foundry, by plotting the results of the drop tests, a consideration of which seems to show that the greatest strength of the white iron is accompanied by the greatest hardness, though the variation due to composition, or any cause other than flaws in the test specimens, is small. Representative drop tests on the half-chilled 1½ in. by 2½ in. bars with the white iron down or in tension, are shown in Table 2. The difference in the amount of chilled iron is at or near the neutral axis and has very small effect on the strength.

In order to get a direct measure of the strength of the flange we have been drop-testing the flange of the wheels on a small

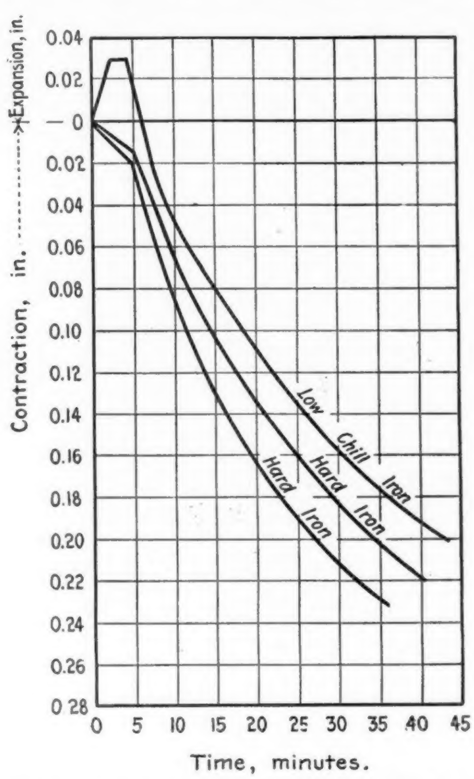
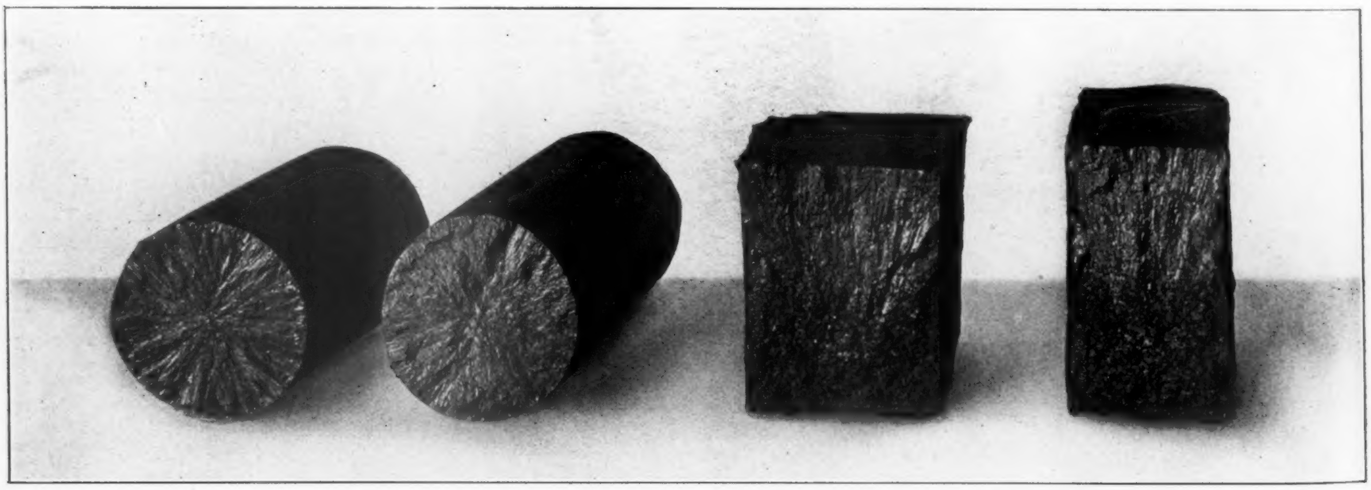


Fig. 6—Shrinkage Curves for 1 In. Square Bar, 12 In. Long, Wheel Iron, Cast in Sand

drop-testing machine, with a 25 lb. tup falling on a striking block 2 in. wide with a face having the contour of the throat of the flange. After some experimenting 6 ft. was taken as the height from which to drop the weight, and we have found that for the same mixture the number of blows to break off the flange is inversely as the chill. This means that a soft wheel has the strongest flange. In service we have more stripped flanges in soft wheels than in hard, but this is due to the development of cracks in the throat of the flange. This suggests that the design of the wheel and care in securing enough chill are more important than differences in quality of the iron.



(a) (b) (c)

Fig. 5—(a) Ends of Two Chilled Rolls; (b) End of Chill Block; (c) End of Partly Chilled Rectangular Block

A possible improvement in wheel iron, to avoid trouble with broken wheels, is the making of an iron with a low coefficient of expansion under brake action. Heavy braking results in heating the tread, with consequent expansion and pulling apart of the plates. Thermal tests on a large number of wheels show an increase in diameter of about 1/16 in. after the iron ring has been on two minutes, failure taking place after an increase of 3/64 in. or more, depending on how much white iron or combined carbon is in the plates of the wheel. The harder the wheel the more readily it is broken in the thermal test. Part cooling curves for wheel iron are shown in Fig. 6. Note the expansion in cooling of one wheel mixture which was soft. A wheel poured from this would have the flange and tread chilled and set at once and the expansion due to the gray iron behind might cause some checking of the chilled iron, which would show as a defect developed later in service. So too it has been thought by some that brake heating produces circumferential throat seams, due to expansion of the tread which is resisted by the flange. If low-expansion iron is a possibility this tendency would be lessened.

Experiments have been in progress for some time. The fuels used have been high and low-sulphur cokes and anthracite coal; and the mixtures have varied from all-scrap wheels to charcoal iron with malleable and steel scrap. Six test wheels have been cast from each test heat, of which two each have been thermal, drop and flange tested. Up to the present there has been no improvement on our standard mixture containing scrap steel. Our test work is to continue and it is our expectation that we will find mixtures and perhaps methods to improve the cast iron wheel.

DISCUSSION

Great emphasis was placed on the desirability of a perfectly even chill in the tread of a car wheel, and attention was called to variations in depth of ⅛ in. to ¼ in. A mechanically operated chill was described by which this end could be obtained. It consists of a number of segmental blocks which are moved in towards the tread as it contracts in cooling.

One speaker took exception to the practice of substituting coke for charcoal iron and maintained that it is impossible to obtain the same evenness and depth of the chill with coke that could be obtained with charcoal. It was maintained that the reason for this superiority lay in the fact that charcoal iron contained more oxygen than coke iron and had the property of retaining it through the cupola; and that this gave an added strength to the metal that could be obtained in no other way. It was the general opinion, however, that it is chemical composition that is the controlling factor in the making of a car wheel, melting and pouring being the same, and that it is a matter of indifference as to whether the iron be made in a charcoal furnace or not.

EATING IN THE FOUNDRY.—Both the states of New York and Illinois absolutely prohibit eating in the foundry. New York requires that suitable quarters be maintained to enable the workers to take their meals elsewhere in the establishment. Illinois specifies lunch rooms wherever practicable. Eating amid the dust and fumes of the foundry is plainly objectionable, as is the handling of chewing tobacco without washing the hands. The practice of allowing a period of 10 or 15 minutes in the middle of the morning for the eating of food brought into the foundry, which is a relic of days when the hours of labor were much longer, and is still common, especially in some parts of the Middle West, is reprehensible, as it does not allow time enough for the workers to go to and from the lunch room, and means that food is eaten amid dust and with dirty hands. Such a recess is hardly necessary with modern hours of labor, but, if given, should be long enough to allow washing and the use of the lunch room.—*From Brass Furnace Practice, by H. W. Gillett.*

INTERCHANGE INSPECTORS AND CAR FOREMEN'S CONVENTION

The fourteenth annual convention of the Chief Interchange Car Inspectors and Car Foremen's Association was held in Hotel Sinton, Cincinnati, Ohio, August 25-27, President F. C. Schultz, chief interchange inspector, Chicago, presiding. The convention was opened with a prayer by Rev. Henry C. Martin, of St. Luke's Methodist Church, and the association was welcomed to the city by Mayor Spiegel. The secretary-treasurer reported a cash balance of $31.19, and a membership of 422.

PRESIDENT'S ADDRESS

I want to call at this time the particular attention of the association to a number of changes in the M. C. B. Rules of Interchange, which I think are important and should result in revolutionizing the handling of car equipment in this country. Rule No. 1 provides that each railway company must give to foreign equipment the same attention in the way of repairs that it gives to its own cars, and in discussing this rule during our meeting here, I hope that the members will place such interpretation upon this rule as will result in carrying out the intention of the framers of this rule, which, as I understand it, means that foreign equipment away from home will hereafter not be neglected. I hope further that the interpretation placed upon this rule at this meeting will result in a condition that will prevent cars not fit for service from being interchanged after October 1. It is up to those who have charge of repairs to see that this matter is put squarely up to their car foremen to see that this rule is carried out. The benefits to be gained from carrying out the wishes of the framers of this rule are that the investment of the car equipment in this country will be materially reduced, for the reason that we have heretofore been obliged to carry a maximum amount of equipment, in order to take the place of that large percentage which is continually in bad order, and therefore unfit for service. From observations I have personally made I predict that, if the equipment is kept in shape as the rule provides, the number of cars necessary to carry on the commerce of this country can be reduced at least 5 per cent, and the saving in the cost of this equipment is apparent. I also wish to call attention to the footnote under M. C. B. Rules 37 to 42, which permits us to inspect a combination of worn out and decayed parts, and authorize the handling line to make the repairs and bill the car owner. This rule is a step in advance, but in carrying it out I hope that those in charge of the car department will administer this rule in fairness, and not saddle on the car owner the cost of damage which is due to unfair usage instead of wear and tear as this rule intends. The operation of this rule will work out a hardship on car owners unless it is carried out honestly. A very decided step in advance has also been made in the change in M. C. B. Rule 120 and the elimination of Rule 121.

When these rules go into effect, I clearly see the necessity of a practical man to pass upon the bills rendered under the foot note under Rules 37 to 42, and to make a decision as to the advisability of requesting the handling line to repair or destroy the equipment reported under Rule 120. I also see the necessity of the railroad companies providing at large terminals sufficient facilities to take care of the foreign equipment that will necessarily be held up at large interchange points as the result of the enforcement of these rules. This can best be accomplished by the co-operation of the interested lines who should establish joint car shops in localities where the equipment necessarily will accumulate, and for the further reason that it is far more economical to carry a stock of foreign material at one or two locations in a large terminal than require each railroad company to stock up with that material. Also the car shop men employed by the railroads can do more efficient work on their

own cars than they can when they are being switched on a miscellaneous lot of equipment. This will result in increased output, and also better work on foreign cars, as the men employed in the joint shops will become more familiar with this equipment. In addition to this cars destroyed under Rule 120 will provide a lot of good material that can be applied to cars that are to be repaired and not destroyed. Such facilities should in my opinion be located in territories where there are a large number of cars unloaded and an equal demand for empty cars for loading. This practice will eliminate the necessity of delivering empty cars for loading in this territory, resulting in a large saving in per diem, as well as in switching charges.

I also wish to call particular attention to the necessity of our members thoroughly familiarizing themselves with the Safety Appliance Laws, and to see that cars are not offered in interchange with defective safety appliances, and that when equipment is found with these defects, it is seen that it is promptly repaired.

I want to remind the members of the fact that we are here especially for the purpose of discussing and arriving at an understanding of the rules that have been adopted by the Master Car Builders' Association. Attention is also called to the growing feeling that the services of car inspectors can be utilized other than for the purpose of car inspection, and that they can properly record and handle seal records, and such other data that is necessary to make complete interchange reports in addition to the mechanical records now taken by them. This practice has now gone beyond the experimental stage, and is being encouraged by the executive officers of the railroads. All our members should assist in every way possible so that this practice can be extended.

DISCUSSION OF THE M. C. B. RULES OF INTERCHANGE

Rule 1—The members seem to fully understand that this rule requires as complete and efficient repairs to foreign equipment as would be given to equipment of their own company, and that no distinction is to be made whatever. It was not taken, however, to mean that each road was to maintain the periodic inspections and attentions that are standard on some foreign roads, such as the repacking of journal boxes, etc. The car foremen were cautioned that in order to fully comply with this rule they must get their shops in condition to handle this work. It was believed that the strict adherence to this rule would keep all cars in much better shape and eliminate a great deal of the damaged empty car mileage all over the country, as well as materially decrease the car shortage. In connection with this rule one member spoke of a complaint by a mechanical officer that the repair bills received from foreign lines greatly exceeded those chargeable to foreign lines. He was told that this was caused by his road not keeping its equipment in proper shape, and that as many repairs were not made to the foreign equipment as might have been made provided his road had the proper shop facilities.

Rule 2—Trouble has been experienced in the matter of carding old defects that in the mind of the inspector at the previous interchange point was not cardable, thus making the delivering line responsible, where, as a matter of fact, they received the car in its present condition. In a case like this it was believed that the first inspector should make note of such defects in order to protect the line to which he delivers the car. Local arrangements are sometimes made where loaded cars with cardable defects are allowed to proceed to their destination for unloading, provided the distance is not too great, the delivery line agreeing to take the car back. This is done to eliminate the cost of transferring the load, and where the car is safe to run to its destination this practice is believed justifiable. However, when the new rules go into effect, it is believed that the inspection should be tightened down and the above practice eliminated. In the matter of refuse in cars, the delivering line is held responsible, and the cars are considered as bad order cars.

Rule 3—The question was raised as to whether it was permissible to apply doors and fastenings to empty cars previously loaded with rough freight, and charge the car owner for this work, provided the car was to be reloaded in a service that required these attachments even though the car was marked "For rough freight only," and contained a notation that no doors or fastenings were required. This is to be referred to the M. C. B. Arbitration Committee.

Rule 4—Trouble has been experienced in the case of wrecked cars where all of the defects were not carded at the first interchange point on account of the inability of the inspector to accurately determine the full extent of the damage. Technically this makes the line delivering the car home responsible for the additional defects found at the joint inspection with the owner and the inspector, although it is known that defects were caused by the wreck. In cases such as these it was believed that if the first inspector was informed immediately, the original defect card could and should be corrected. Most of the trouble has been experienced where this was not done until some considerable time after the car was received home. One chief interchange inspector allows the car to proceed on "notation," and does not attempt to make out a defect card until the full extent of the damage has been ascertained. Some of the members desired a definite rule covering these conditions.

Rule 20—It was believed proper and permissible to bill car owners for placing shims in center bearings and side bearings on pedestal trucks in order to raise the coupler to its proper height. In the case of Fox trucks the shimming of the springs was deemed advisable and good practice.

Rule 42—The interpretation given to the foot note under this rule is that in case of damage done to new or substantial parts on account of decayed or unduly worn parts the owner will be responsible up to a combination of defects of new or substantial parts. In the latter case the delivering line will be charged for the combination and the owner for the decayed or worn parts. The chief interchange inspector must use his judgment in determining whether defects come under this rule or Rule 120, as no definite line can be drawn between these two rules on account of the varying nature of the damages or defects.

Rule 115—A question was raised as to just what "individual ownership" meant, and the consensus of opinion seemed to be that private car lines were intended. It was decided that individual ownership meant private car lines, the reason being given that these lines find satisfactory use for trucks of 50,000 lb. capacity.

Rule 120—While this rule relieves the necessity for obtaining home route cards, and leaves only two options for the car owners to choose, it does not give a definite time in which the owner of the car is to give authority for its destruction or rebuilding. This has previously caused a great deal of trouble under the old rules, and the roads that would try to live up to the rules strictly found their repair tracks overloaded, and oftentimes waited a year or 18 months for the necessary authority to dispose of the car. The members believed that a time limit was absolutely necessary, and are to petition the M. C. B. Association to request the railroads to give joint inspection reports on this rule their immediate attention, or to make some arrangement whereby the road holding the car can act on the joint inspection after a certain time has expired. The Lake Shore makes a practice of investigating load transfers that are charged to them with a view of eliminating the trouble at the source. It was believed that if this was more generally done much better results could be obtained. Honesty is the basis of the successful operation of this rule, and all inspectors must clearly keep this in mind.

The following officers were elected: President, F. H. Hanson, assistant master car builder, Lake Shore & Michigan Southern; vice-president, A. Kipp, chief car inspector, New York, Ontario & Western; secretary-treasurer, Stephen Skidmore, Big Four.

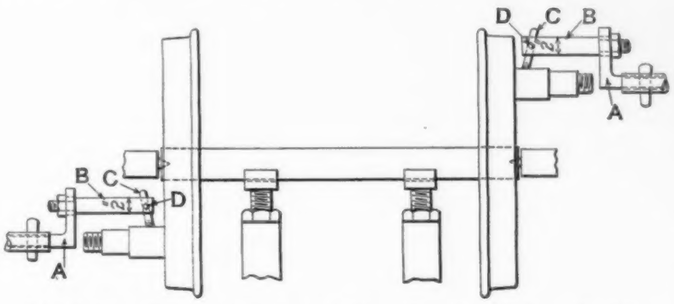
SHOP PRACTICE

TURNING CRANK PINS IN A QUARTERING MACHINE

BY R. F. CALVERT

The drawing shows an attachment used at the Horton, Kan., shops of the Chicago, Rock Island & Pacific for turning crank pins in a quartering machine. This shop has no special machine for doing this class of work, nor has it the attachment for use on the wheel lathe. Therefore this method of turning pins in the quartering machine was devised and has been in use for several years.

The attachment consists of but two pieces aside from the tool. The piece *A* is a wrought iron angle or casting. One end is



Attachment for Turning Crank Pins in a Quartering Machine

made to fit the socket in the tool post, in which it is held tightly by a taper key. The other end, which is about 3 in. x 1¼ in., is slotted about 2 in. for a 1¼ in. rod. This slot allows adjustment of the tool post *C* for different size pins. Tool post *C* is a round rolled steel post 2 in. in diameter by 10 in. long, turned down to 1¼ in. for about 3 in. on one end, and threaded for 2 in. from the end. The other end is bored or broached to take the tool, which is secured by a set screw. This device will be found useful in shops not equipped with the special devices for doing this class of work and also in the more up-to-date shops where the other machines are rushed.

DIES FOR FORGING RUNNING BOARD SADDLES

BY J. LEE

The dies illustrated are used on a No. 5 Ajax bulldozer for the manufacture of pressed steel running board saddles for box car roofs. The type of saddle is shown in detail in Figs. 1

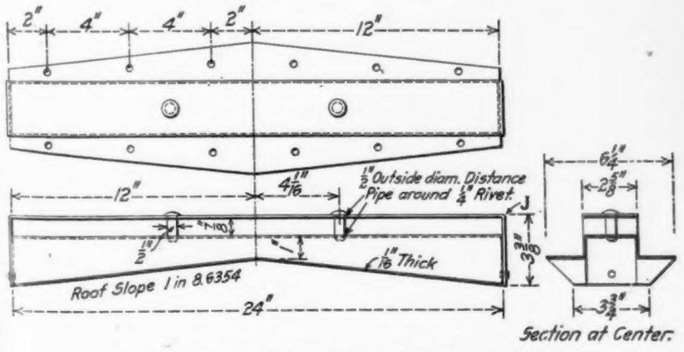


Fig. 1—Pressed Steel Running Board Saddle

and 2. The arrangement of the dies is shown in Figs. 3 and 4, *B* and *C* being the moving and stationary dies respectively. Blanks are first cut in the form shown in Fig. 2, the holes and slots all being punched in one operation by means of a die on another bulldozer.

In operating the dies the blank is placed in the machine in front of, and against the stripper *D* on die *C*, with the end against gage *A*. The moving die then makes the stroke

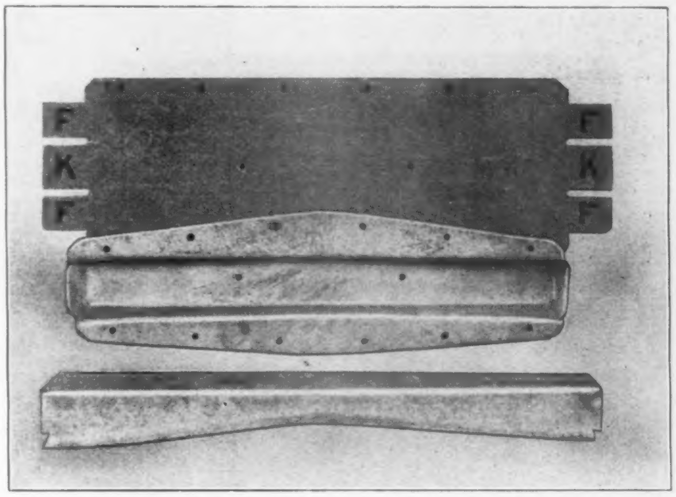


Fig. 2—Completed Saddle, and Blank from which it is Forged

and forms the saddle around die *C*. The tools *HH*, one of which is removed to show the interior of die *B*, form the ends *K*. A feature of the die *B* is the clamping and stripping device, consisting of four projecting pins *E*, which are held out by heavy springs; this works in conjunction with the stripper on die *C*, rigidly clamping the stock during the stroke of the machine. When the moving die has moved forward a certain portion of

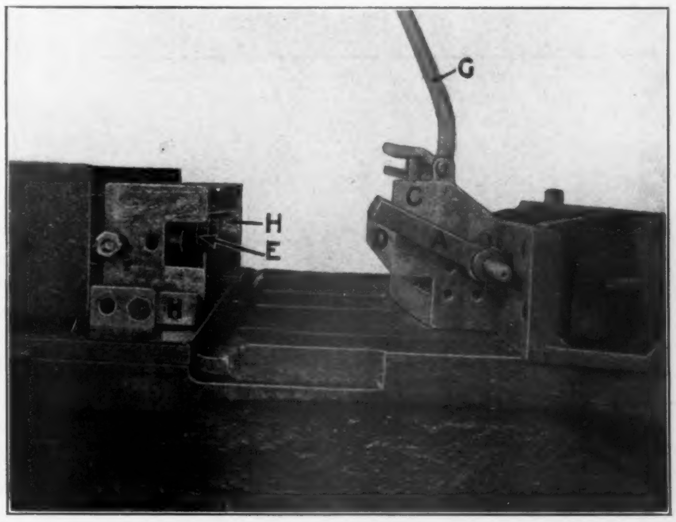


Fig. 3—Dies in Place on the Bulldozer, Showing Stripper D Locked in Compressed Position

the stroke, these pins are forced in by the stock, which is held securely against the stripper *D*, and as the stroke is completed, both the stripper and pins are forced flush with the die faces. As the moving die returns to rest, the pins resume their former extended position ready for the next stroke. These pins act as strippers, ensuring that the form is left on the stationary die. The stripper *D*, which is spring operated, does not resume its

extended position, being automatically locked flush with the die face, as shown in Fig. 3, by two pins which are attached to the handle *G*. Before removing the saddle from the machine, ends *FF* are bent over by hand. This completes the saddle and the

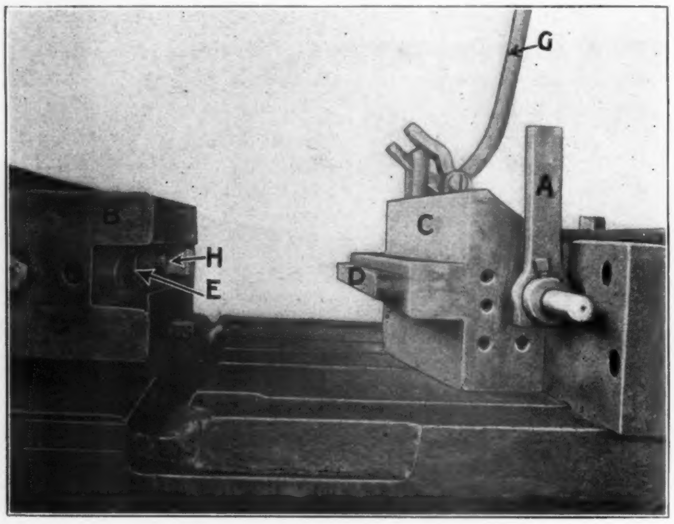


Fig. 4—Stripper D in Release Position

stripper is then released by raising handle *G*, when it resumes the position shown in Fig. 4, and removes the saddle from the die.

The strap shown at *J* in Fig. 1 is also made with the same dies. This requires the application of a packing strip, Fig. 5, which is bolted around the projecting portion of the stationary die to make up the difference in depth. This has an extended slot in its face through which the stripper works. The gage *A* is also moved along the spindle to the required length. The tools *HH* on the moving die have an offset, and are reversed to accommodate the thicker stock in the strap. With these changes the dies are ready for use in bending the straps.

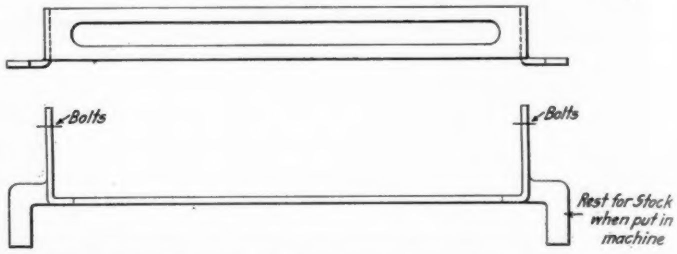
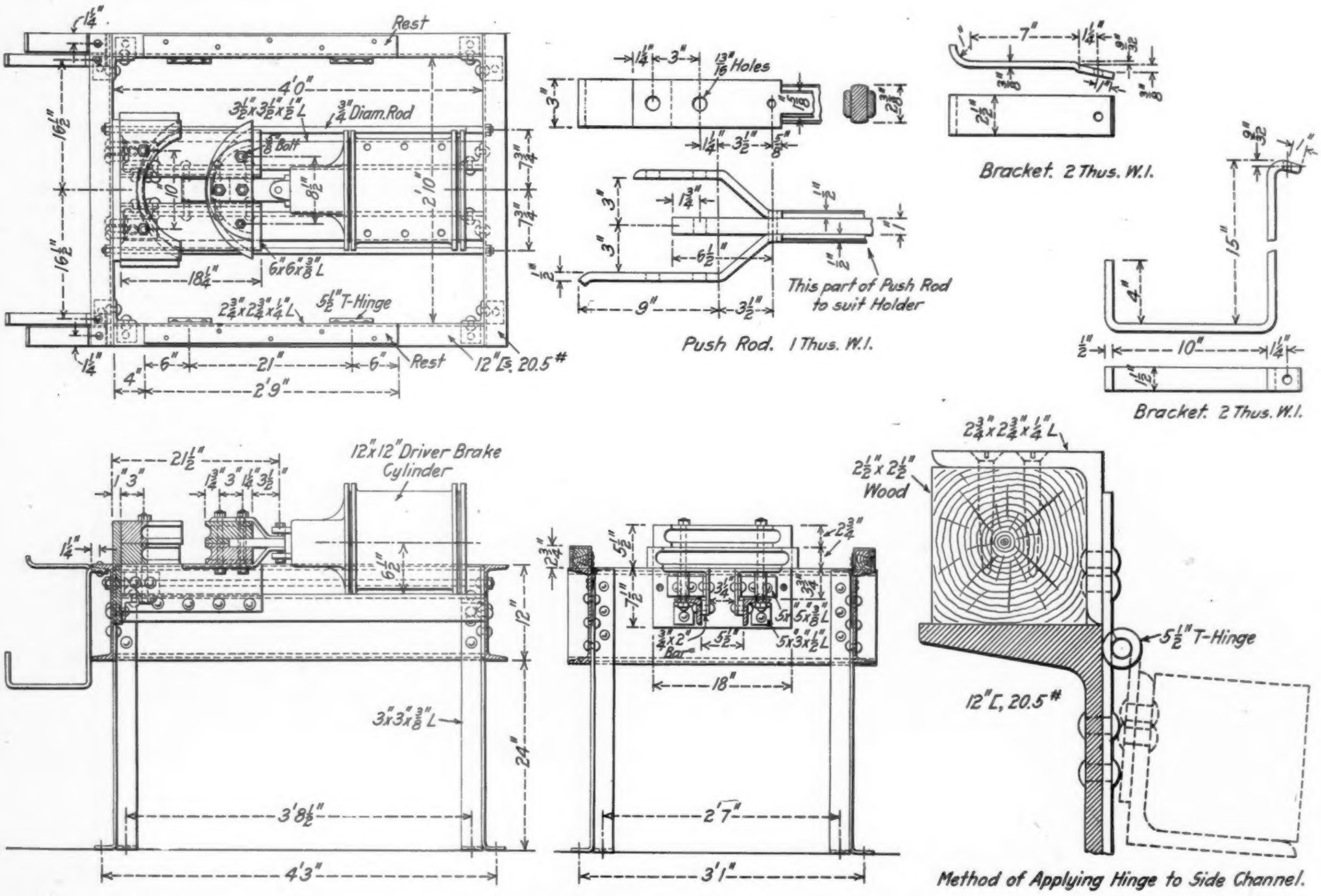


Fig. 5—Extension Used on Stationary Die When Forging Saddle Straps

PIPE BENDING MACHINE

BY PAUL R. DUFFEY

A pipe bending machine, the construction of which is shown in the drawing, is a very serviceable pneumatic device for use on the car and shop tracks. The double bending die permits the bending of pipe to either a large or small radius. Hinged blocks are attached to the channel side frames, and when using the upper die these serve to support the pipe in line with the die. When not in use they may be turned down inside of the frames, thus leaving the top of the frames in line for the lower die. The 12 in. brake cylinder which operates the dies holds the pipe rigidly in place, with no chance for slipping. With proper manipulation this machine very much lessens the chance or crushing pipe in making short bends.



Pipe Bending Machine for Shop or Car Repair Tracks

Organization of Engine House Forces

Prize Article of Recent Competition Also Touches On Equipment for 36-Stall House and Machine Shop

BY R. G. GILBRIDE
Locomotive Foreman, Grand Trunk Pacific, Graham, Ont.

The matter of organization of the average engine house is left largely to the foreman, and depends to a large extent on general conditions and the volume of traffic handled. On the railways on which I have been employed the stores department has been a separate department and under the control of a general store-

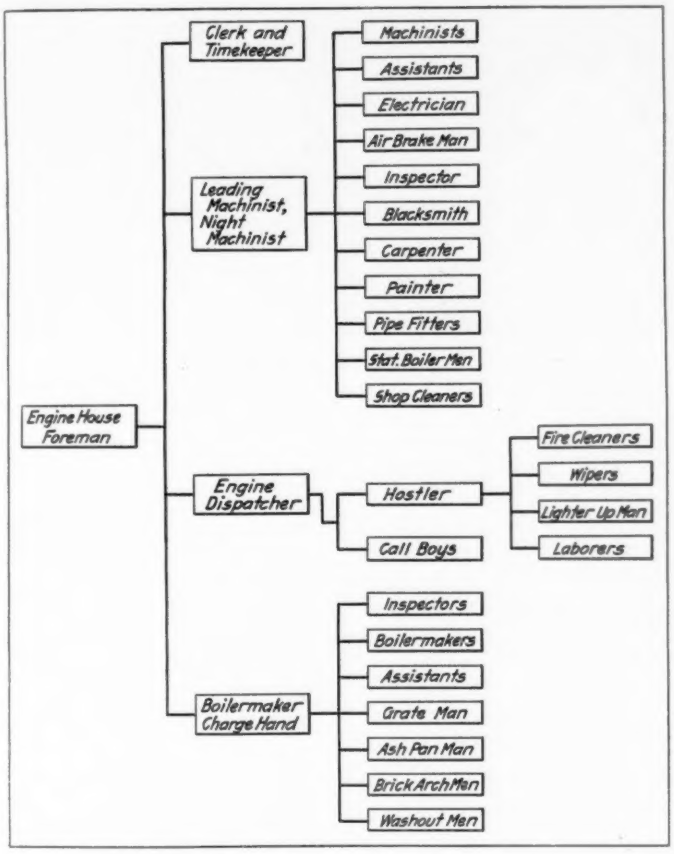


Fig. 1—Organization Chart

keeper, while the handling of coal was under the fuel department, the work being done by a contractor on the tonnage basis. This I consider the best practice, as it is more economical and relieves an already overcrowded foreman of work that properly should not belong to him.

The engine house organization shown on the accompanying chart, Fig. 1, is recommended. A coal chute of either the ramp type or the mechanical type, having two coaling tracks and with sand delivery to each track, should be used, the tracks leading directly to the inspection pit and ash pit tracks, which should be equipped with an air cinder hoist. The engineer, on arrival at the shop, should place his engine on the coaling track, and after making his usual inspection, the engine should be taken charge of by the hostler. The hostler's first duty should be to examine the crown sheet and see that the enginemen do not remove any tools belonging to the engine equipment. After the engine is coaled, sanded, and moved over the ash and inspection pits, it is placed in the engine house. During this time the engineer books in on the rest or register book provided for that purpose, and shown in Fig. 2, and reports the necessary work on the work book. This work book can be made with carbon sheets attached in triplicate if desired, to save copying the work reports, but I have obtained the best results with the work book in which the men make the one report, which is copied by either the leading machinist or a man assigned to the work. The engine crew should be instructed to report the work in the following order:

(1) All boiler work, including grate gear, ashpan, and front end work;

(2) Air brake work;

(3) Machinist's work and minor repairs to cab, pilot, etc.

By this time the shop inspector will have completed his inspection and made his report in the shop inspection book, which should be inspected daily by the foreman, and where engineers have failed to make the proper inspection, the matter should be brought to their attention. The locomotive should be inspected by the boilermaker immediately after it has arrived in the shop, as to the condition of the grates, tubes, brick arch, ashpan and other fire prevention parts.

The work reports and engine inspector's report are then handed to the various workmen by the leading machinist, who should endeavor to specialize the various classes of mechanics as much as possible, and arrange for any machine shop work, especially if new parts are to be gotten out. When the work has been completed, the various workmen hand their work slip back to the leading machinist and go to the work book and sign for what repairs they have made; this is very important in the event of law suits when questions may arise as to what work has been done. The leading machinist then O. K.'s the machine work to the engine despatcher, and also O. K.'s the machine work on the call board, the boilermaker charge hand following the same routine. This can be handled through a shop telephone system. The hostler then notifies the lighter-up men to put a fire in the engine, but this should not be necessary if the men are at all interested in their work, as they will then anticipate the completion of the repairs, and be ready to put in the fire at once. However, it is not always advisable to have an engine lighted up at this time when the movement of traffic is not heavy. Care should be exercised in the use of the blower.

A washout board, having room for all of the engines assigned to the terminal, and dated from the first to the thirty-first of

Enginemen's Register and Rest Book at ______ For (day) ______ (date) ______ 19___

No. of Engine	No. of Train	Engineer	Fireman	Where From	Departure Time			Arrival Time			Engineers			Firemen			Remarks
					Date	A.M.	P.M.	Date	A.M.	P.M.	Hours on Road	Hours rest in previous 24 hours	Hours rest wanted	Hours on Road	Hours rest in previous 24 hours	Hours rest wanted	

Fig. 2—Register and Rest Book

the month, should be displayed in close proximity to the engine despatcher's desk. This board shows the date each engine is

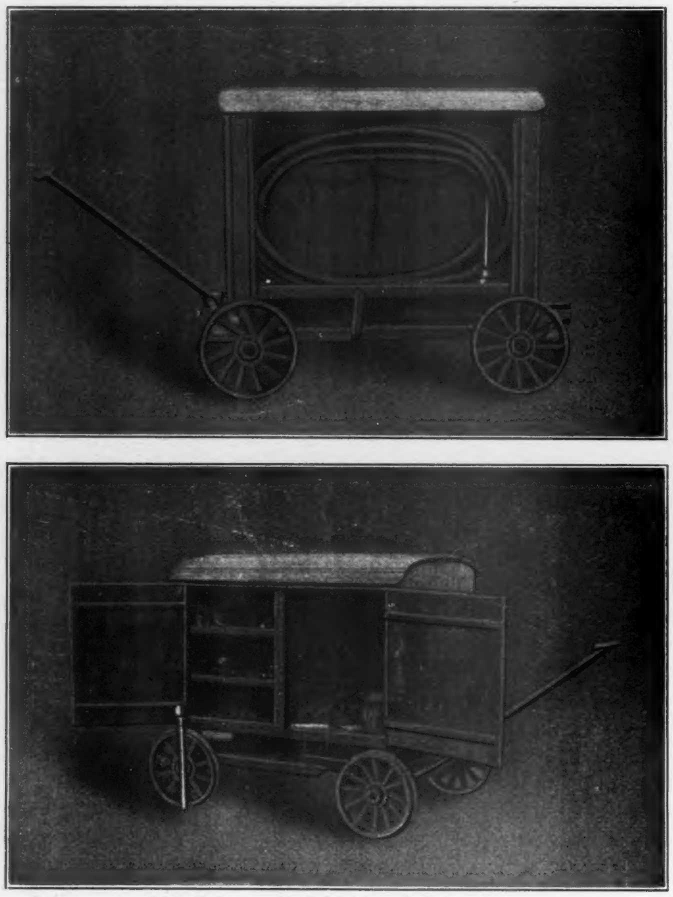


Fig. 3—Wagon for Washout Equipment

due for washout, or if on a mileage basis, the mileage made each trip. The board is kept up to date by the engine despatcher, acting under the foreman's instructions. The hostlers then cannot fail to know just what engines are due for washout, and should place them accordingly. The washout gang should be provided with a suitable washout cart, similar to the one shown in Fig. 3, capable of holding all of their tools and the washout hose, as there is a great loss of time from this class of labor moving their tools and hose from engine to engine. Spare washout plugs should be kept in this cart. The cart is mounted on hand car wheels, and has room for the men's clothes, and the lower shelf holds their long box wrenches and cleaning rods. On the reverse side a recess about 8 in. or 12 in. deep is made for the storing of the washout hose. The cart is easily made,

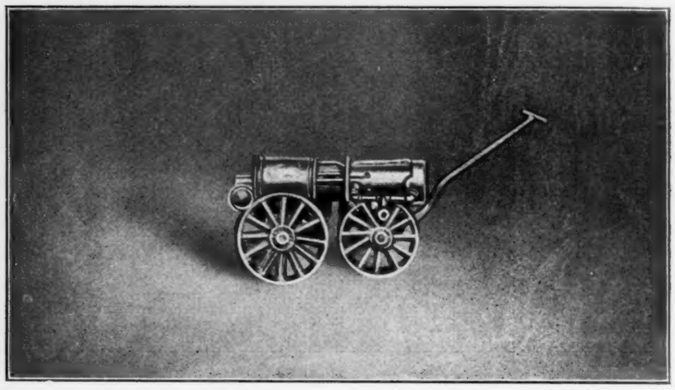


Fig. 4—Portable Test Pump

and with the use of old material costs about $10. The system of washing out with hot water and blowing off through a blow off line is now practically general.

As soon as the washout is completed the inspector should go over the engine and make out the necessary cab cards and office records. Cab valves should be repacked, if necessary, at this time as well as the try cocks cleaned out and the gage glasses changed. One man should be assigned to this work, as it requires special tools, and he is also called upon to make records as to the condition of the gages, etc.

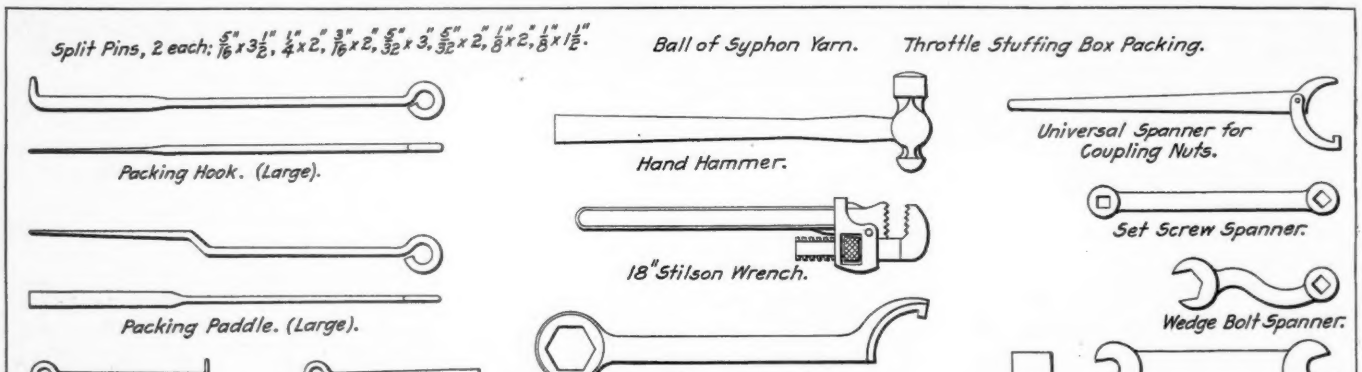
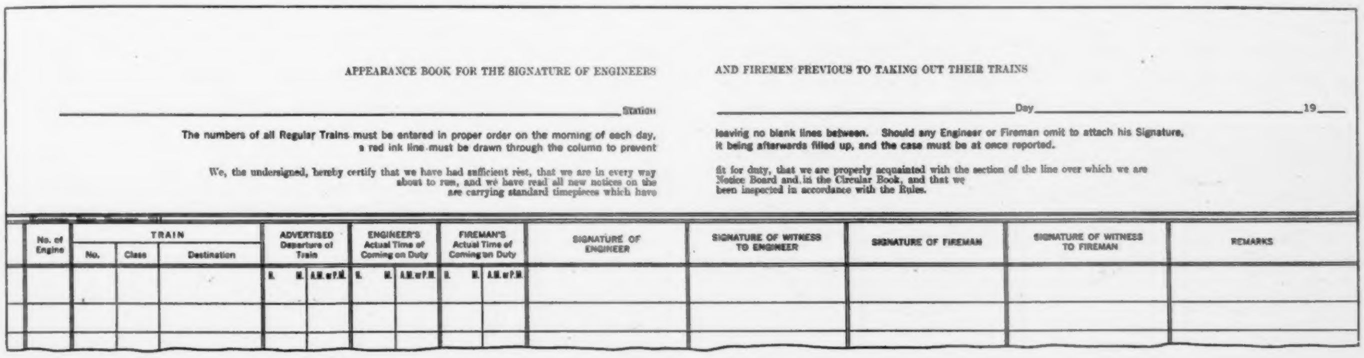


Fig. 5—Equipment for Locomotive Tool Boxes

The washout gang also make all hydrostatic tests which are required by the government. For this purpose a handy arrangement is the portable test pump shown in Fig. 4. It is also mounted on two old hand car wheels and was made from a discarded 8 in. air pump, the air cylinder being removed and a water cylinder of smaller diameter applied. By coupling to the


APPEARANCE BOOK FOR THE SIGNATURE OF ENGINEERS AND FIREMEN PREVIOUS TO TAKING OUT THEIR TRAINS

__________ Station __________ Day __________ 19____

The numbers of all Regular Trains must be entered in proper order on the morning of each day, a red ink line must be drawn through the column to prevent

leaving no blank lines between. Should any Engineer or Fireman omit to attach his Signature, it being afterwards filled up, and the case must be at once reported.

We, the undersigned, hereby certify that we have had sufficient rest, that we are in every way about to run, and we have read all new notices on the are carrying standard timepieces which have

fit for duty, that we are properly acquainted with the section of the line over which we are Notice Board and in the Circular Book, and that we been inspected in accordance with the Rules.

No. of Engine	TRAIN			ADVERTISED Departure of Train			ENGINEER'S Actual Time of Coming on Duty			FIREMAN'S Actual Time of Coming on Duty			SIGNATURE OF ENGINEER	SIGNATURE OF WITNESS TO ENGINEER	SIGNATURE OF FIREMAN	SIGNATURE OF WITNESS TO FIREMAN	REMARKS
	No.	Class	Destination	H.	M.	A.M. or P.M.	H.	M.	A.M. or P.M.	H.	M.	A.M. or P.M.					

Fig. 6—Appearance Book

water and air line, a quick and reliable test can be made; this is also convenient for making tests of steam and exhaust pipes.

For outgoing extra freight engines, or anything except regular engines, the transportation department should present regular printed order blanks in duplicate at least two hours before the

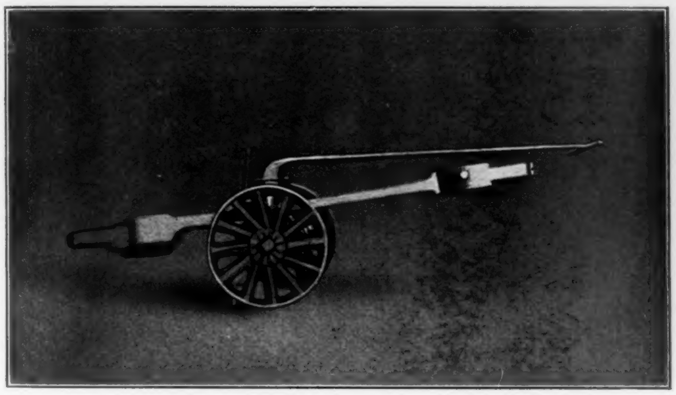


Fig. 7—Two-Wheel Truck for Carrying Rods

time the engine is required. The order blanks should be made with a perforated bottom stub, which the engine despatcher fills in and hands to the transportation department call boy when supplying power. The upper portion is filed by the engine despatcher, with particulars as to the engine number and the

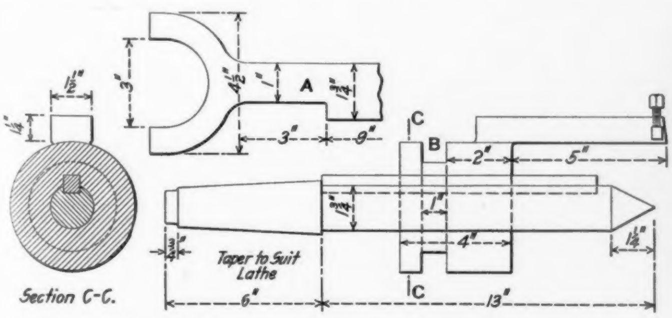


Fig. 8—Tool for Turning Tumbling Shafts

time supplied entered on it. The transportation department call boy then pins the stub to the duplicate to be filed by that department. This duplicate is for use in the event of the motive power department being unable to furnish the power when required, as notations are then made on the back of the two orders as to the cause of delay. If the engine cannot be supplied before the expiration of 24 hours, the order is annulled. The practice of stating the cause of not supplying power prevents any discussion at a later date on this question, and each department has a record. The orders should be numbered commencing with one at midnight daily.

As soon as the engine is supplied the engine despatcher indicates this on the call board opposite the engine number and the names of the engine crew, showing the time ordered and the direction in which the train runs. The call boy is then despatched with a call book containing the same particulars as on the call

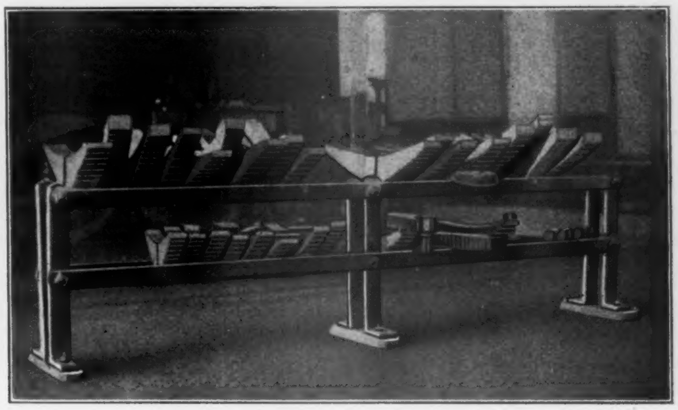


Fig. 9—Spring Rack

board, which the engine crew is required to sign. The call book should be examined by the engine despatcher immediately on the boy's return. The call board used by the writer is about 5 ft. by 5 ft. 10 in., working in a sliding frame so that it can be raised and lowered, and contains the engine number, the train,

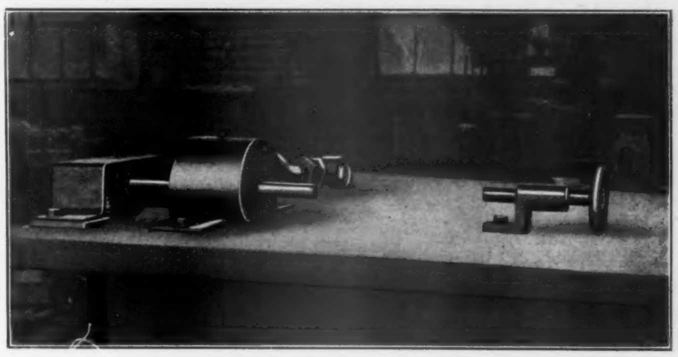


Fig. 10—Turbine Saw and Drill

the time ordered, the names of the crew and three columns for showing the machine work O. K., the boiler work O. K., and the engine fired O. K. At the bottom of the board room is provided for spare men, and men on sick leave or leave of absence.

It is the hostler's duty when taking the engine out to see that

it is properly equipped and also to test both injectors. Situated at the center of the turntable on one side, or in close proximity to the outgoing track, there should be an engineer's tool box rack, made of iron pipe, with shelves to suit the size of the terminal, on which the hostler or engineer will place the tool boxes when the engine is coming in, and remove them when going out. Fig. 5 shows the standard equipment recommended for the engineer's tool box.

The engine crew on arrival at the engine house must sign the appearance book, the form of which is shown in Fig. 6, their

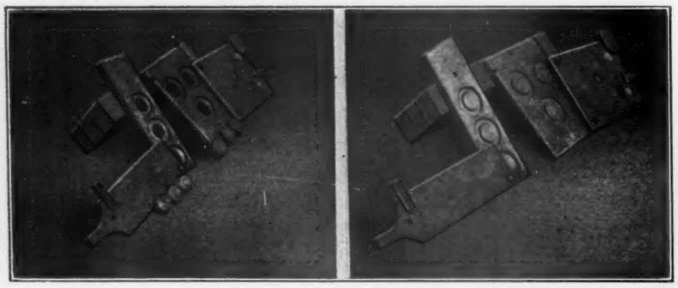


Fig. 11—Plates for Molding Metallic Packing

signatures being witnessed by the hostler or the engine despatcher. Either the hostler or the engine despatcher should also be required to note the time that the engine leaves the shop tracks, and whether there are any delays. This is very important as while, of course, the transportation department will never attempt to place any blame for delay on the motive power department, yet this information sometimes proves extremely useful.

In the handling of the repair work, endeavor should be made by the foreman to specialize as much as possible; one man should be assigned to go over the electric headlight equipment, and another to side rod work. If the inspector is not too busy he can also tighten up all loose nuts that he finds, and look after the setting up of wedges and the replacing of tender journals. The renewal of piston rings and their examination should be at regular intervals, and at the time this is done the date should

Fig. 12—Iron Storage Rack

be stenciled on the inside of the cylinder casing. Thus R. 12-1-14 would indicate that the cylinder rings were renewed on this date, and if they were only examined, the letter E is used.

At a terminal of this size a heavy repair gang should be maintained, independent of the running repair men, to handle the renewal of side rod bushings and driving box brasses, heavy repairs to motion work, the turning of tires and all work of a general repair nature. This will assist greatly in keeping the power out of the back shop longer. For the handling of side rods, couplers, air pumps, draw bars, and springs, a two-wheeled truck like that shown in Fig. 7 is convenient. This is made from 1½ in. iron with a yoke rising above the center line of the wheels, and a second hand pair of hand car wheels is used.

Most foremen at outside stations where they have only a small lathe have trouble when an engine comes in with a broken tumbling shaft, which requires a large lathe to swing it. To turn the ends without bending the arm, the device shown in Fig. 8 will prove of great value. A guide *A* is fitted into the tool rest and the fingers engage in the recess marked *B*. There is a key-way on the tapered center, and by using the feed this tool will do the work quite satisfactorily. The spring rack shown in Fig. 9 is made from 1 in. by 3 in. flat iron and needs no special description. The air motor shown in Fig. 10 has a saw for metallic packing on one end and the other will hold a drill socket for drilling staybolts, or it may be used for buffing. The center part of this air motor was made from an old side rod bushing, bored eccentric and fitted with slots in which are set four blades ¼ in. by 2 in. by 4 in.; the feed is through 1¼ in. pipe cut down

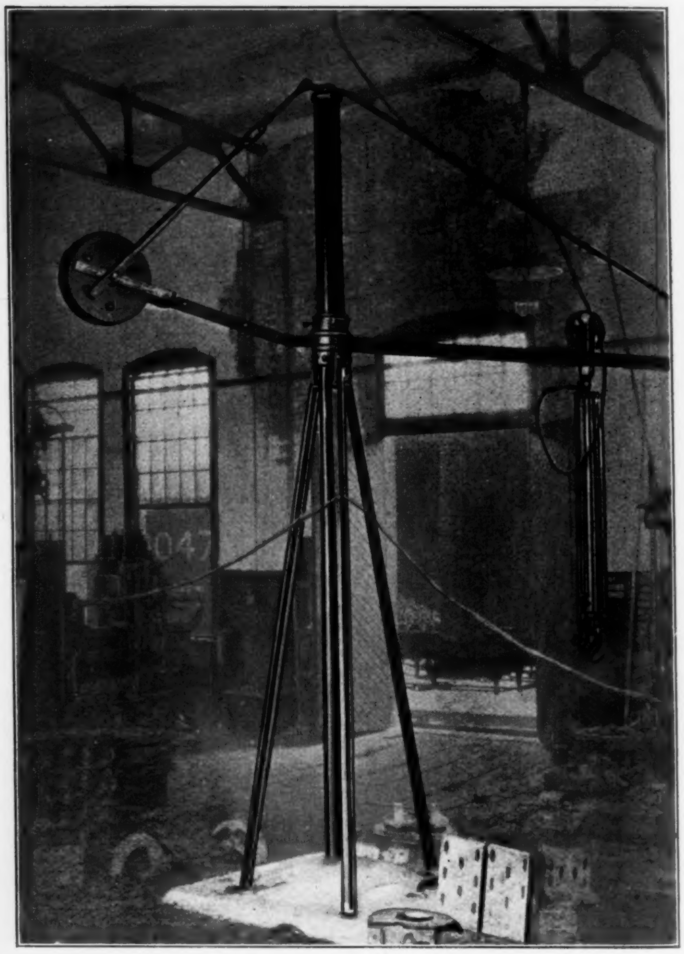


Fig. 13—Air Hoist and Crane

to ½ in. opening where it enters the motor and the exhaust is underneath. This avoids the use of hack saw blades.

The plates shown in Fig. 11 are for making metallic packing. They were made from second hand balance plates, and if care is taken in the molding, the packing does not require turning after it is made. Fig. 12 shows an iron storage rack which can also be used for tubes or piping. This is made from old rails held in place by ¾ in. bolts and iron pipe. The upper portion with the doors is for storing brass castings or other valuable material.

Fig. 13 shows an air hoist and crane which can be made very cheaply. The center pillar is made from a 6 in. piece of pipe and the side supports are small sized rails. The 6 in. pipe is screwed into a broken steam chest cover imbedded in concrete and the counterbalance is a piston head that was scrapped. The pipe itself was filled with concrete when put in position. This machine serves the planer, two drills and the hydraulic press. The carrier bar is a rail with the flat side up.

Master Blacksmiths' Convention

Including Papers on Spring-Making, Frame Repairing, Casehardening, Heat Treatment of Metals and Shop Kinks

The twenty-second annual convention of the International Railroad Master Blacksmiths' Association was held August 18-20 at the Hotel Wisconsin, Milwaukee, Wis., H. E. Gamble, of the Pennsylvania Railroad at Altoona, Pa., president of the association, presiding. The opening prayer was offered by Dr. Levi and the association was welcomed to the city by the mayor of Milwaukee. Addresses of welcome were made by A. E. Manchester, superintendent of motive power; J. J. Hennessey, master car builder, and J. F. Devoy, assistant superintendent of motive power, of the Chicago, Milwaukee & St. Paul.

PRESIDENT'S ADDRESS

The Pennsylvania Railroad in the year just closed carried 111,000,000 passengers without having a single train accident in which a passenger was killed. The blacksmith certainly played a part in this achievement. "Safety First" should be the watchword of this association. We are striving, and have been successful all these years, to find out the best ways and means to do our work, so as to protect the traveling public and the many companies we represent. Why not look up "Safety First" for those about us in the mills and shops, training the men under us to protect one another? We have in our smith shop at Altoona a smith whose duty it is to dress the heads of all tools from all over the plant, such as keys, drifts and pins, used so much in the boiler shop, as well as our own tools in the smith shop. Men will get careless, and we think that by having this smith set apart for this class of work we have prevented many an accident. A "Safety First" blacksmith is a good asset for any shop.

There is nothing like exchanging ideas. Let us all work for better methods in doing our work; stop, think and listen; always consult the men above you; be sure you are right; cultivate the habit of getting there, no matter what size shop you have. Come to these conventions and feel at home. Tell us something, it all counts; no member can afford to say nothing.

ADDRESS BY A. E. MANCHESTER

A. E. Manchester, superintendent of motive power, Chicago, Milwaukee & St. Paul, addressed the convention in part as follows:

Your association is one of those that have helped, by better methods and management, to make up for some of the losses in the earnings due to increased taxes and higher rates for material and wages, railroading standing almost alone among the industries as the one that has steadily and constantly reduced the rates on the things it had for sale, namely, transportation, and at the same time has to a large extent improved its quality. But the unfortunate feature of this all is that the public, the purchasers and users of this commodity, fail to appreciate the fact that they are receiving the best and cheapest transportation in the world, and it ought to be one of the aims and efforts of every association to work for the bettering of the methods of railroad building, maintaining and operation, and let their lights so shine that wherever an opportunity affords they will bring forth these thoughts in a form that will help to bring a better understanding of true conditions to the minds of the general public.

To illustrate, the railroad with which I am associated has, since the year 1875, reduced its average rate of transportation from 2.5 cents per ton per mile to a rate of 0.79 cents per ton per mile for the year which closed June 30, 1913. You will see from this that the road now receives an amount equal to one-third for the unit of service as compared with 1875.

Can you think of any other commodity that is today sold at any such a depreciated rate? When these matters are referred to, the answer will probably be that your railroad is vastly over-capitalized, and that you are looking for a return on a fictitious capital, but these statements are made without a true knowledge of the facts. As to the rate received for transportation, a year ago the average rate for all the railroads in the United States was 0.75 cents per ton per mile for moving freight. In England they received 2.5 cents, in Germany, 1.44 cents, and in France 1.39 cents. If the rates received in the United States were equal to those paid in the European countries, the railroads here could readily meet almost any demand that might be made upon them so far as taxation, rates of pay, etc., went and still pay a reasonable dividend on the investment in the property.

I recall a few years ago attending a political meeting, in which the speaker was trying to show what great things his party had done for the good of the people of Wisconsin. He said, "We are building in Madison a new capitol building; it will be one of the finest in the United States, and will cost about $6,000,000 to build. You will not have to pay one penny of the cost of building that building; it will all be taken out of the railroads." And the people cheered; that was a great hit. The party was getting something for nothing, and they were to get the benefits. It is such a feeling and spirit as this that has got to be corrected and better understood before railroads will have a fair chance to maintain or improve their conditions.

CARBON AND HIGH SPEED STEEL

George F. Hinkens, Westinghouse Air Brake Company: To determine the proper forging heat for high speed steel is a matter of experience on the part of the tool smith. Care must be exercised not to work it at too low a heat, as it will cause the crystals to crush and rupture. It is dangerous to forge it after the temperature has dropped below a bright yellow. There are as many methods for hardening high speed steel as there are brands. One method that gives good results is to heat slowly up to the sweating point, or about 2,200 deg. F., after which cool the cutting point of the tool in oil (if lathe or planer tool), and when thoroughly black, cool rapidly in compressed air blast. In hardening taps, threading dies, reamers and milling cutters made from high speed tool steel, it is good practice to insist on slow pre-heating in a furnace at a temperature of 1,500 deg. F. and then submit to a temperature of 2,200 deg. F. or move to an adjacent furnace.

The Westinghouse Air Brake Company anneal high speed steel by placing it in a tube or pipe large enough in diameter and length to accommodate the work. Both ends of the tube are provided with a screw cap. After the work is placed in the tube and before screwing on the cap we put in from a tablespoonful to a handful of resin, screw on the cap, heat for six hours and let the pipe and contents cool with furnace gradually to atmospheric temperature. Work of large bulk is heated in an open furnace at 1,450 deg. F. for six hours. It is then removed and buried in hot burnt casehardening compounds or extremely hot ashes and left there until cold.

Furnaces used for hardening high speed steel should be so constructed that the oxygen of the air from the blast and fuel opening will not attack the metal, as this would result in scale, blisters, uneven heating, cracking in hardening and general bad results. A furnace within a furnace would be

ideal. Such a furnace would prevent the oxygen of the air from attacking the work and would be suitable for large pieces, such as drop hammer dies. For smaller pieces a muffle should be used.

H. A. Hatfield, Canadian Car & Foundry Company: In ordering steel a careful study should be made of the conditions to be taken care of and full information furnished with the order; by doing this there can be no misunderstanding of what grade of steel is required and the manufacturer will be in a better position to provide the steel required.

By testing new bars of steel for hardness and stamping each piece taken from it with the hardness number it will enable the tool smith to better regulate his work and permit of establishing standards that will give the best results. Considerable information can be gained from an examination

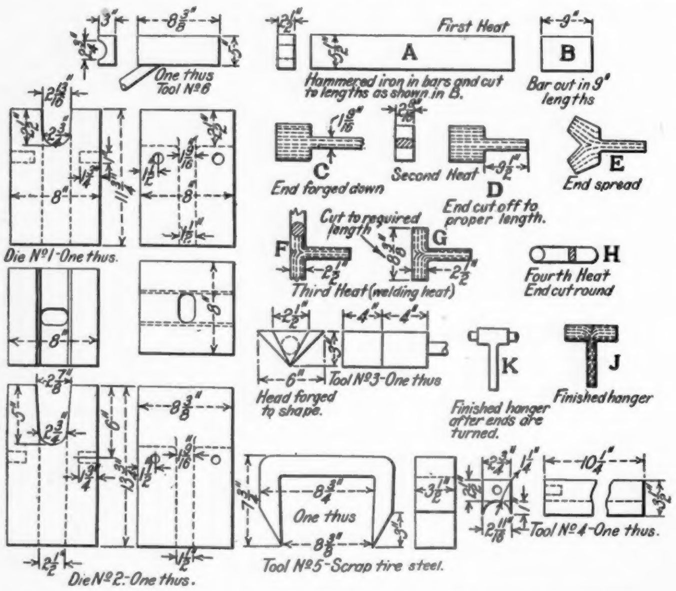


Fig. 1—Dies for Forging Spring Hangers for Tender Trucks

of the fracture of the bar when it is broken, provided it is broken under standard conditions, that will aid the expert tool smith in hardening the tools. The hardness testing machine is of particular value in establishing standards and its constant use is advisable for this end. In doing this work the tools of different hardnesses should be watched carefully in the shop and their service noted. Its use will also permit of making more detailed requisitions for material. The hardness alone, however, does not indicate the perfect tool, for oftentimes overheated tools may have the requisite hardness and break on account of being overheated.

In selecting a furnace a design should be chosen that may be readily repaired. The burner provided should permit of close regulation. In fact, every point should be carefully considered. The direct vision spectroscope has been found very satisfactory in determining the temperature of the work in the furnace.

TOOLS AND FORMERS

H. G. Sharpley, Lima Locomotive Corporation: With the introduction of the modern smith shop machines it is necessary for the smith shop foreman to devise suitable tools and formers to use in them so that they may develop the greatest efficiency. In doing this the total cost must be carefully considered and this should include the increased overhead expense occasioned by the more expensive machines. The smith shop foreman must keep in close touch with the foreman of the tool room and co-operate with him in keeping the tools in proper working condition.

J. W. McDonald, Pennsylvania Railroad: The following dies and formers are very easily made and have given good results:

Fig. 1 shows the dies and method of forging spring hangers used on tender trucks. On account of not having a forging machine large enough to make these hangers, I was compelled to make them under a steam hammer. The stock *A* is roughed down to size and cut to length as shown at *B*. It is then reheated and the end reduced as shown at *C*. The end is then cut to length as shown at *D*. The forging is then placed in die No. 1, and with tool No. 3 the top is spread so as to start the fibres of iron as shown at *E*. In the next operation the iron is reheated to a welding heat, placed in die No. 2, and, using tool No. 4, the top end is forged down as shown at *F*. With the same heat and the same die with tool No. 5, both ends of the hanger are cut off at the same time to proper length as shown at *G*. In the fourth heat the bottom of the hanger is cut half round as shown at *H* and *J*. This completes the hanger in the rough; *K* shows the finished hanger after the ends are turned on the machine. Several of these hangers after being completed in the rough were sawed in about six or eight sections, then given an acid test to learn positively if the fibre of the metal had the flow in the proper direction. In all cases it was found that the metal had flown as intended and as indicated by the dotted lines at *G* and *J*. The finished hanger is shown in Fig. 2

Fig. 3 shows dies for bending steam pipe flanges on a pneumatic bending machine equipped with an 18 in. cylinder, 30¾ in. stroke. With this attachment you can produce work of this kind at a very low cost, as well as reducing the hard labor that is involved when they are made by hand. These rings are as near perfect as can be made. You will note that the ends of the iron do not meet within ¾ in. This allowance is made for scarfing which is done on one side only. The plunger head is bridged to allow the ends of the rings to pass under while

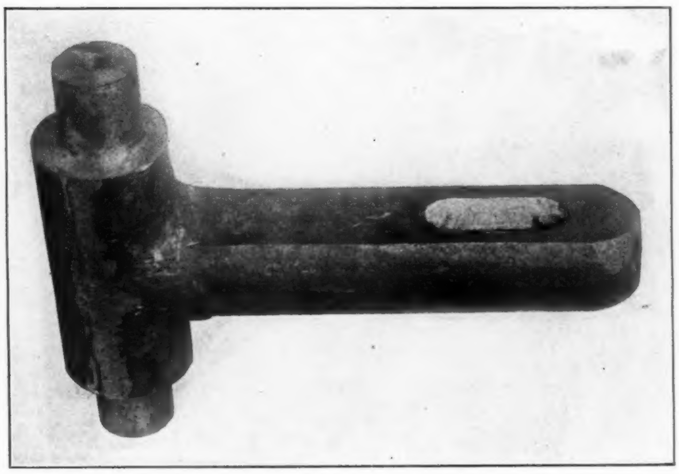


Fig. 2—Finished Hanger Made in the Die Shown in Fig. 1

bending; also the head is hinged on the back end so that it may be raised to remove the ring after bending. An elliptical ring is formed with the same die by using a shoe on the face of both formers, corresponding to the shape of the ring desired. When welding either ring, use round iron to fill in the scarf. This is accomplished by taking a separate heat on each piece, and permits of welding in one heat.

Fig. 4 shows dies for making ashpan connecting jaws. The amount of metal required to make this jaw cannot be gathered from a ⅝ in. by 2 in. bar. To overcome this difficulty we first punch pieces to the shape shown at *A*. We then punch a 7/16 in. hole on the 1 15/16 in. end, and also punch a 7/16 in. hole in the straight piece of ⅝ in. by 2 in. iron, then rivet the three parts together just sufficient to carry them to the machine for welding. The completed forging is shown in Fig. 5. In this way we get a very satisfactory job at a very low cost, as there is no slotting work necessary. Up until the time we designed this die, this piece was forged solid at the steam hammer, and the center was slotted out in the machine shop. The cost for

slotting exceeded the cost of the complete jaw, as it is now made in the forging machine in the smith shop. I recently completed 100 of these jaws. This work is done on a 2½ in. machine.

Fig. 6 shows dies designed to form the back end of the back flue sheet brace. This piece is first roughed out under the steam hammer, then taken to the machine and upset and punched at the same heat. This makes a very clean piece of work as compared with making by hand. The hole is punched with one blow, by doing which the metal is much less liable to be fractured than if done by hand. The work is done on a 2½ in. machine.

DROP FORGING

The gist of the papers and discussion on this subject is as follows: Many times fully as good work may be accomplished

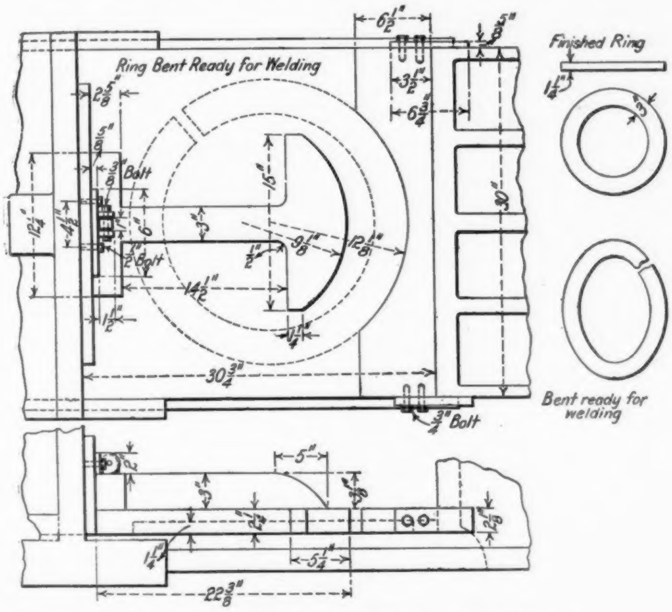


Fig. 3—Dies for Bending Steam Pipe Rings

under the steam hammer as is done with drop forge hammers. Those shops that do operate this class of machinery, however, have found that considerable saving can be made by the proper design of dies where there is a large quantity of work to be made. In small orders that do not require a large quantity, cast iron dies are used with very good success, although it is stated that they do not give the finish that a steel die does. Cast iron dies are good for rough work and for blanking out work that requires two operations. Where standards are maintained throughout the system the drop forging machines may be used to great advantage with a minimum number of dies. One member uses scrap axles for dies and finds that they will give from 5,000 to 18,000 pieces. From 50 point to 60 point carbon was recommended as being the best steel for dies.

Numerous cases were cited where it was found impossible to get machine shops to furnish the dies required, and in some instances the foremen were obliged to resort to cast iron dies in order to get the work out, as they could get them made much easier. This, of course, was believed to be poor practice and the members thought that if proper co-operation was received from the machine shop better results could be obtained and more work accomplished. Considerable discussion was centered in designing the dies so that the metal would flow properly. The upper die should be the deeper of the two, as it has been found that the metal will flow upward better than it will flow downward. In some cases it has been found advisable to place a vent in the die so that the air may escape, and thus facilitate the flowing of the metal. The clearance in the dies will be in accordance with the shape of the work that is to be forged, and where the required clearance is greater than that called for by the drawing the trimmers can be used to take out the surplus metal.

SPRING MAKING AND REPAIRING

F. F. Hoeffle, Louisville & Nashville: Care should be taken to see that the proper grade and kind of steel is obtained for the springs. Springs should be set so that when they bear the greatest load they will carry it in an almost straight position. The condition of the roadbed has a great deal to do with the success and life of springs, as also do flat wheels, low joints, etc. All the plates in the spring should be of equal thickness so that the load will be distributed proportionately to all plates. In general, tempering must be suited to the amount of carbon contained in the steel. When using oil for quenching, a little fresh oil should be added every day or so to replace the burnt oil, and when the whole mass becomes pretty well burned it should all be changed, as worn out oil loses its power and will not give the desired results.

F. B. Nielsen, Oregon Short Line: A record of the life of springs should be kept by punching the dates on the bands when a spring is placed on or removed from an engine. The Oregon Short Line has been experimenting with vanadium steel for springs and finds that if it is treated properly it is much superior to carbon steel. A pyrometer should be used to determine the accurate temperature, for otherwise the best results will not be obtained.

DISCUSSION

John Carruthers, Duluth, Missabe & Northern, stated that he had excellent results with vanadium steel springs. These springs are heated to 1,700 deg. F. and set to the proper shape, then cooled in oil. They are then reheated to 1,650 deg. F., and again cooled in oil. They are then tempered in a tin bath of 1,000 deg. F., as it has been found that they will float in a lead bath.

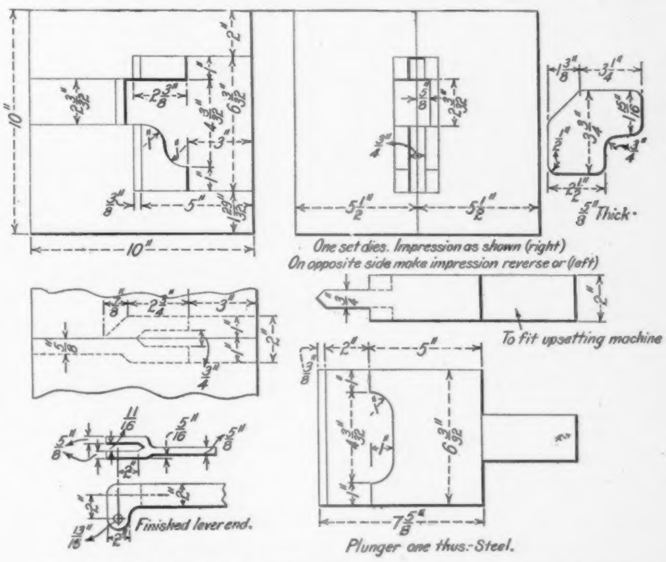


Fig. 4—Dies for Making Connecting Jaws on Ashpan Levers

In order to do the work properly a pyrometer is used to record all temperatures. The carbon steel springs are heated to 1,600 deg. F .and tempered in a 750-deg. bath. It has been found that by heating the old springs they can be brought back to their proper shape and flexibility. Some members took exception to this process, believing that it was not necessary to quench the vanadium steel springs after they have been set, stating that they would put the springs back into the furnace, bringing them up to the required heat and then quench them in oil, proceeding the same as did Mr. Carruthers.

It was pointed out that the springs were not always responsible for the failures, as it has been found in some cases that they have been forced into compression so that short spring hangers may be used. This was, of course, deemed very bad practice.

On the Chicago & North Western the practice is to make all the springs in the Chicago shops for the whole system. The springs are carefully tested and standard lengths of spring hangers are used so that the springs will not be unduly compressed in application. As the old springs pass through the shops they are brought up to standard. Carbon steel is used entirely on this road.

FRAME MAKING AND REPAIRING

Geo. Hutton, New York Central & Hudson River: By means of the electric welding process and the oxy-acetylene burners it is now possible to make most any weld on the engine. At our West Albany shops we have not had a frame off an engine on account of breakage in eight months and only three in two years. All the welding is done by electricity; we have not used oil in two years. A point that should be carefully considered in making frames is the annealing and heat treatment of them, especially cast steel and vanadium. I believe that much better results will be obtained and much less breakage experienced if all frames are heat treated as well as annealed.

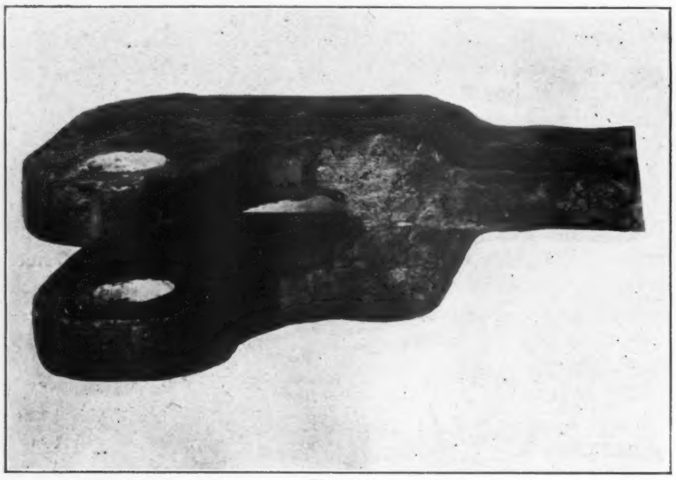


Fig. 5—Jaws Made in the Dies Shown in Fig. 4

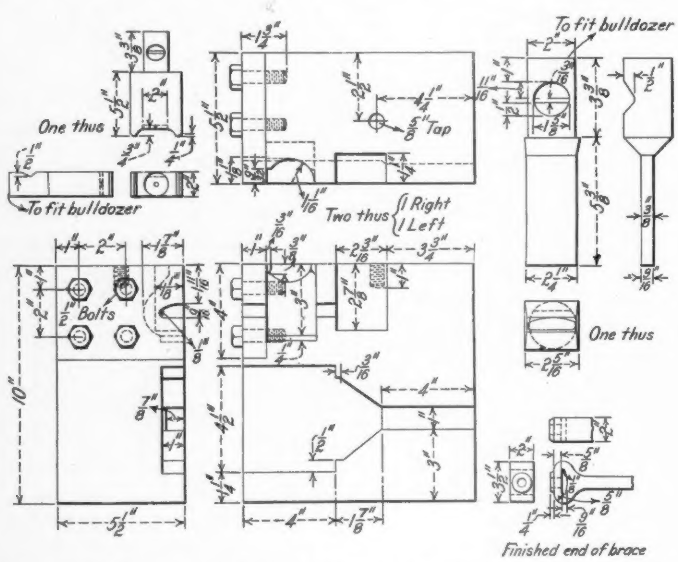


Fig. 6—Dies for Forging the Back End of Back Tube Sheet Braces

C. E. Lewis, Pennsylvania Railroad, Baltimore: The best way to weld a frame is at the forge, but often it is not expedient to remove the frame from the engine and in this case good judgment must be used. When cost is considered oil is cheaper than Thermit and the work can be done more quickly. There are many places where Thermit can be used and oil cannot. The main point in welding a frame is to see that it is properly preheated. All welded frames should be annealed after welding by leaving the furnaces on until the frame has become cool.

Ill-fitting pedestal caps and the drop of engines on turntables, which often amounts to as much as 3 in., are a great cause of frame breakages. The practice of applying clamps to frames rather than welding them at once is bad practice, as it is liable to cause the frame to break in other places.

J. N. Poland, Richmond, Fredricksburg & Potomac: We use both the Thermit and the electric welding processes and both give excellent results. Out of 65 frames welded by electricity only one has broken and that was on account of being made too close to a Thermit weld. It has been found that the electric process will not weld Thermit metal. In welding frames two men are required, so that the metal may be filled in on both sides at the same time. The frame is heated before starting to weld and the welding done quickly in order to avoid too much expansion.

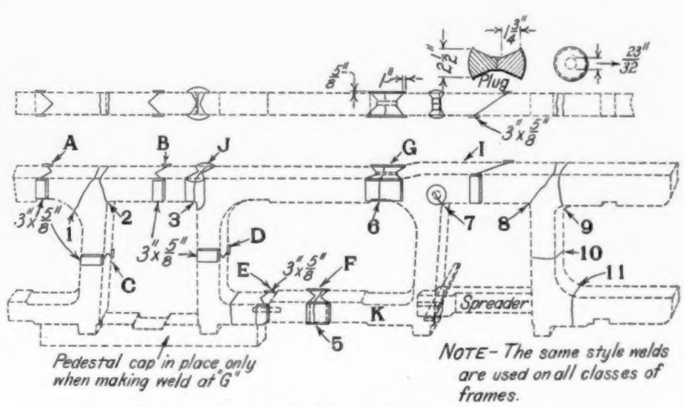


Fig. 7—Method of Making Oil Welds in a Locomotive Frame

Note

1—When a frame is broken at the pedestal as shown at *1* or *2*, the corner is cut out at *A*, *B* and *C*, the ends shaped and a new corner is then fitted and placed in position. Pieces of iron 3 in. by ⅝ in. are fastened with a small stud on each side of the frame at the points where welds *A*, *B* and *C* are to be made, with the grain of the metal running parallel with the grain in the frame; then each point is heated and welded.

2—When the frame is broken at the pedestal as shown at *3*, the frame is cut out as shown and a piece of metal is shaped to fit and allowed to extend beyond each side of the frame; heat is then applied and the weld made.

3—When the frame is broken at the heel of the pedestal as shown at *4*, the heel is cut off at *D* and *E*, a new piece fitted and a 1-in. dowel pin inserted at *E* to carry the weight of the heel and keep it in line while welding; pieces of iron are placed at the weld as in the case of breaks *1* and *2*. Heat is applied and the weld made at *E* and then at *D*.

4—When the bottom member of the frame is broken as shown at *5* the frame is cut out, block fitted, plates put in position and the weld made at *F*.

5—When the top member of the frame is broken through the spring hanger opening as at *6*, the frame is cut out on each side of the opening the full length of the slot, the spreader is then placed between the pedestal jaws and expanded until the opening at *6* is increased 5/16 in., then a block is fitted and plates applied as at *G*. A charcoal fire is then applied to the bottom member of the frame at *K* (but red heat is not permitted); at the same time heat is applied to *G* for making the weld. The charcoal fire is to be removed after the weld is made to allow the weld and bottom member to cool evenly. The spreader should be released gradually as the temperature of the frame decreases.

6—When the main frame is broken at the front end as shown at *8*, *9*, *10* and *11*, the end back to *I* is removed and a new end is fitted and bolted to the front frame and heat applied. As the temperature increases the spreader between the pedestal jaws should be expanded and the weld made at *I*. The spreader should be released gradually as the temperature of the frame decreases.

7—When the top corner of a pedestal is cracked at *7*, a 29/32-in. hole is drilled through the frame at the end of the crack, then counterbored 1¾ in. deep on each side by 2½ in. in diameter outside. Two plugs are fitted, one on each side, coming together as shown in the small sketch; heat is applied and the weld made at *H*. The grain in all fitting blocks and plates should run parallel with the grain in frame.

U. R. Pratt, Charleston & Western Carolina: Thermit is the best material to be used when it is impossible to take the frame into the smith shop for repairs. Good hammered iron frames give much the better results and our records show that they cost less for repairs. Where possible we cut out V's on both sides of the break, clamp up the frame

and weld in dutchmen on both sides, making sure that the grain runs the same as the frame.

DISCUSSION

Several members stated that they believed better results could be obtained with cast steel frames if they were heat-treated in addition to being annealed, as it was believed that the annealing did not remove all of the internal strain. The various processes of frame welding, oil, Thermit and electric,

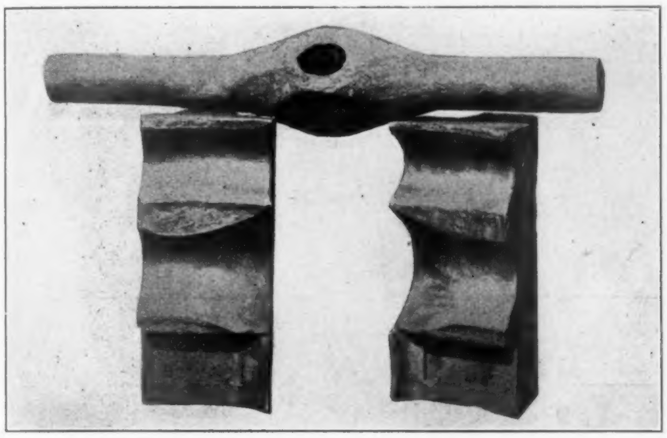


Fig. 8—Spike Maul and Dies for Forming It

all had their adherents, several members having obtained first class results with all of these processes. It was the consensus of opinion, however, that where possible broken frames should be taken to the shop for repairs, as it was believed that a more substantial weld could be made on the forge fire.

J. S. Sullivan, Pittsburgh, Cincinnati, Chicago & St. Louis, described his method of repairing cracks in the fillets at the head of the pedestal jaws. Two holes are drilled at the end of the crack and on each side for the full depth of the crack. The frame is then heated and a chisel bar is placed on the bridge between the holes and driven in. This forces the metal out and welds the crack, the fillet being hammered back into shape with a fuller. A dutchman is used when the crack extends all the way through, a hole being drilled through the frame at the end of the crack.

J. W. McDonald, Pennsylvania Railroad, presented a drawing showing the methods of welding locomotive frames with oil without removing them from the engine. This is shown in Fig. 7.

Fig. 9—Steam Hammer Die for Making Safety Chain Plates

OXY-ACETYLENE WELDING AND CUTTING

T. E. Williams, Chicago & North Western, gave a general description of the oxy-acetylene process and stated that the oxy-acetylene outfits have a wide range of usefulness and where used have met with success in welding broken castings, locomotive boilers, and other general items. One of the most striking examples is that of building up flat stops on tires. The old method would require the tire to be turned off at a total expense of about $100, whereas they can be placed in good condition by welding with oxy-acetylene for $6.21. A broken spoke in a trailing wheel was repaired by oxy-acetylene for $7.41, making a saving of $32.59. This process can also be used in building up worn holes in crosshead shoes, crossheads, etc., making a very material saving.

CASEHARDENING

P. T. Lavender, Norfolk & Western: At the Roanoke shops we use a 20 in. by 20 in. by 48 in. cast iron box for casehardening. A 2 in. layer of burnt bone is placed on the bottom and the material to be hardened is placed on this about ¾ in. apart, special care being taken that no two pieces touch. Raw bone is packed between each two pieces. When the box is full it is covered with a 2 in. layer of bone and a lid made of boiler plate covers the box. By using this it is not necessary to use fire clay. A semi-muffled furnace having a perforated arch between the box and the combustion chamber is used. This furnace has flues in the wall opposite the burner that run down to the bottom, giving an outlet under the bottom of the box. This provides a uniform heat. The box is heated to about 1,450 deg. F. and held at that temperature for about 12 hours. The material is then removed and quenched in cold running water. This process gives a casehardening about 1/16 in. to 3/32 in. deep.

D. Huskey, Chicago Great Western: We use a steel box in which is placed a layer of charcoal. On top of this is

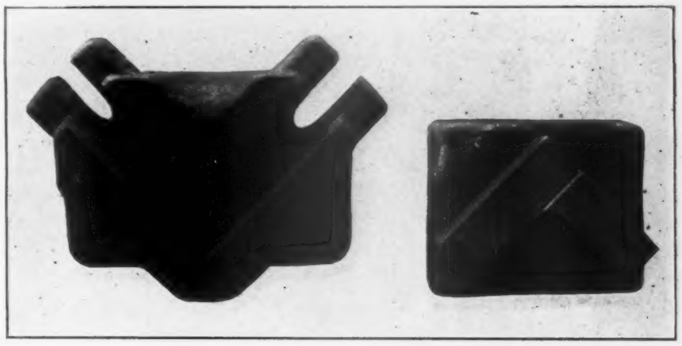


Fig. 10—Dies for Making Engine Truck Frames

firmly packed a 1½ in. layer of cyanide and salt mixture. The material to be hardened is placed on top of this about ½ in. apart and is covered with a layer of cyanide and salt. This process is repeated until the box is filled and it is then covered and sealed with fire clay or sand. The box is heated in an oil furnace to about a lemon color and kept at that heat for from nine to twelve hours. This system produces a casehardened surface about 3/32 in. to 5/64 in. deep.

HEAT TREATMENT OF METALS

H. E. Gamble, Pennsylvania Railroad: The Pennsylvania Railroad has carried on quite a little experimental work in the heat treatment of metals for the last three or four years, but it was not until January 1, 1913, that they decided to apply heat treatment to their locomotives. They have now at the Juniata shops a complete heat-treating plant for the reciprocating parts of all locomotives. Included in these parts are main rods, side rods, axles, crank pins, piston rods, and valve motion parts, as well as a varied line of miscellaneous work. The plant is located in one of the smith shops, and occupies about 60 ft. by 100 ft. of floor space. There has been installed a cylindrical oil-fired furnace, 6 ft. in diameter inside by 16 ft. 6 in. deep, in conjunction with a quenching tank 14 ft. square and 20 ft. deep. The tank is located at the right of the furnace. Next to the tank on the right is

located a horizontal muffle type furnace, oil fired, with a heating chamber 7 ft. wide, 14 ft. long and 30 in. high, the hearth of this furnace being constructed on a car.

A small horizontal muffle type furnace, oil fired, with a heating chamber 4 ft. wide, 7 ft. long and 12 in. high is located near at hand, with oil and water tanks conveniently located, for small work. An electric furnace, with a heating chamber 8 in. by 8 in. by 18 in. long is used for experimental work and the calibration of pyrometers. A crane of 12½ tons capacity, and a span of 54 ft. was installed for handling the work in and out of the furnaces and tanks. The vertical furnace mentioned above is contained in a concrete lined pit, about 12 ft. square and 13 ft. deep, one side of the pit being common with the quenching tank. The furnace is supplied with eight low pressure oil burners, the flame from which is admitted to the furnace at a tangent to the inside circumference. The quenching tank is built of concrete, the sides extending above the floor line about 3 ft. It is lined throughout with 4 in. by 8 in. yellow pine, to protect the sides and bottom from injury. Water is admitted at two points near the bottom through two 4 in. pipes, and passes off at the top through two 6 in. pipes.

While this plant has only been in operation about a year, we have handled quite a lot of steel, including various alloys, such as chrome vanadium, Mayari and nickel; also special chrome. Although we have obtained some very fine results on the alloy axles, we are handling mostly carbon steel, which, after heat treatment, gives us good satisfaction. Our method of treatment of the carbon steel axles is as follows: Heat in the vertical furnace eight hours after the furnace assumes a constant temperature of 1,550 deg. F., quench in water about 70 deg. F. for eight minutes, reheat in the horizontal furnace for eight hours after reaching a constant temperature of between 1,100 and 1,200 deg., then cool in the air after placing on rails in a pyramid, so the parts will cool slowly. A physical test is taken of all heat-treated parts. The sample is taken with a hollow drill, which cuts a core ⅞ in. in diameter by 6 in. long. This work is done on a horizontal boring machine. The physical tests require an elastic limit of 85,000 lb. per sq. in., and an ultimate strength of 120,000 lb. per sq. in., with 20 per cent elongation and 50 per cent reduction in area. Mayari axles are heated to 1,500 deg. F., quenched in water at 70 deg., and reheated to 1,055 deg. F., and allowed to cool in air. The physical tests require a 70,000 lb. per sq. in. elastic limit, a 100,000 lb. per sq. in. ultimate strength, with 20 per cent elongation and 50 per cent reduction in area.

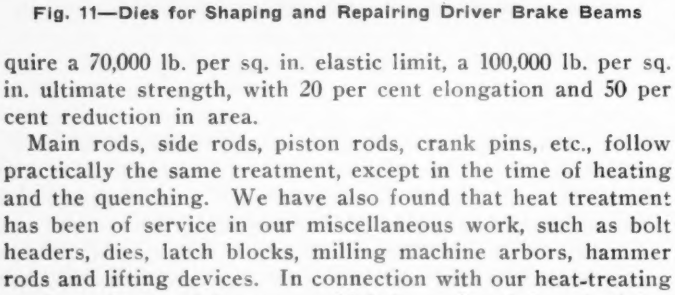


Fig. 11—Dies for Shaping and Repairing Driver Brake Beams

Main rods, side rods, piston rods, crank pins, etc., follow practically the same treatment, except in the time of heating and the quenching. We have also found that heat treatment has been of service in our miscellaneous work, such as bolt headers, dies, latch blocks, milling machine arbors, hammer rods and lifting devices. In connection with our heat-treating work we have a laboratory which is equipped for obtaining chemical analyses of all steels, also a 100,000 lb. tensile machine on which are made the physical tests. The carbon steel axles are required to have an ultimate tensile strength of 85,000 lb., an elastic limit of over 50,000 lb., an elongation of 20 per cent. and a reduction in area of 40 per cent. If the axles pass the physical test, they are given a drop test. Main rods, side rods, piston rods and all long work is handled in a similar manner. Crank pins, return cranks, valve stems, crossheads, crosshead pins, crosshead keys, etc., are handled in the small horizontal furnace, the method of treatment being practically the same.

John M. Keller, Purdue University, submitted to the association a copy of the practice recommended by the American Society for Testing Materials for annealing miscellaneous rolled and forged carbon steel objects as published in their proceedings of 1911.

SHOP KINKS

W. C. Scofield, Illinois Central: Fig. 8 shows dies for a power hammer for drawing out, cutting off and finishing a spike maul in one heat.

Fig. 9 shows a steam hammer die for making ends for safety

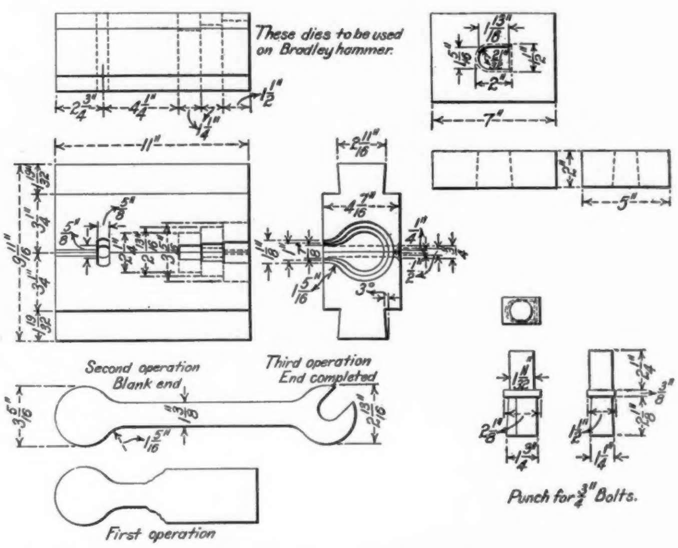


Fig. 12—Dies for Forming Wrenches from Scrap Spring Steel

chains for passenger coaches. The forging is roughed out before using the die. It will be noticed there are two impressions in dies, making it appear as though the forgings are right and left, which is not the case, but the shape of the forging makes it necessary. The heated blank is first placed in one impression and taken out, turned over and placed in the other impression, and as the impression in the bottom die is ⅛ in. deeper than that in the top, this will trim off the flash. This makes a first-class forging and has every appearance of a drop forging.

Fig. 10 shows steam hammer dies for making engine truck frames. It is our practice to draw out bars from scrap iron axles. The first operation is to place the long and short pieces in the dies between adjustable stops and weld under the hammer. The two halves are then clamped together in a jig, heated, and the corners welded in the same die. In the second operation the frame is handled in a crane. This makes a good job and when made in any quantity will prove a paying investment.

Fig. 11 shows steam hammer dies for shaping the ends on new and repaired driver brake beams. In repairing, the end of the beam is brought to a welding heat in a suitable furnace and, at the same time, a piece large enough to fill the worn place is heated welding hot and laid on the end of the beam and welded in the dies. It is turned over in the same impression and trimmed, the bottom being ⅛ in. deeper than the top. It is then placed in the finishing swage in the dies and by using a little water a smooth clean job is made. The end is cut off to the proper length in the dies.

C. V. Landrum, Nashville, Chattanooga & St. Louis: Cast steel

truck bolsters often break about midway between the center bearing and the end, where there are two holes. These are repaired by placing a ¾ in. by 7 in. piece of Empire steel or ⅞ in. by 7 in. iron across the face and up 3 or 4 in. on each side. They are then placed in a fire with the edge down and a welding heat taken for 2 in. up the side. It is worked with a flatter on a cast iron block and then turned up edgewise and swedged. These are repaired at $2 per side, and of the 400 we have done not one has failed at the weld.

W. J. King, Illinois Central, is doing a great deal in reclaiming second-hand iron. The old arch bars are being worked into brake levers and safety hangers, and the round iron into bolts, safety hangers, or anything that can be made from second-hand iron. Old transoms are used for knuckle plates and are also made into new transoms. Old bolts are saved by piecing them out. This work is done by inexpensive handymen, who have kept the plant in bolts for the past five months, eliminating the necessity of making new bolts. Small scrap springs are being made into ripping bars for the car men, and the packing hooks and paddles used in packing hot boxes are made out of discarded 8 in. air cylinder springs. Old tools in the machine shop are being reworked into smaller tools and small high speed steel tools are made for use in tool-holders, all these tools being marked so that the grade may be readily distinguished.

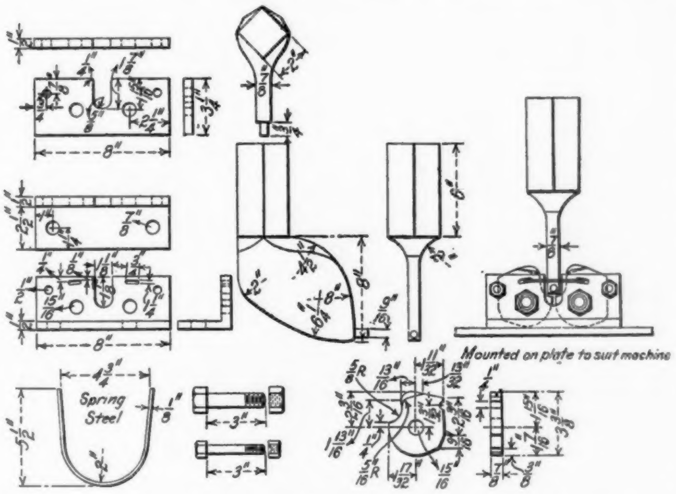


Fig. 13—Dies for Bending Cellar Bolts in a Power Punch

J. W. Riley, Lehigh Valley: Fig. 12 shows dies for forming wrenches from scrap spring steel under the Bradley hammer. These dies can also be used under a steam hammer. By this method a wrench can be made 9/16 in. thick from ⅜ in. scrap spring leaves. These wrenches are forged in two heats and one man can forge on an average of 150 blanks in 10 hours. After they are forged they are punched hot on a power punch with a close-fitting die and are then rattled until they are polished. They are then sized on a small emery wheel where one man can grind 300 in 10 hours. One man will also heat and punch 300 in 10 hours in sizes ranging from ⅜ in. to 1¼ in. Wrenches too large to be made from spring steel are forged from tire steel to the required size and handled the same as with spring steel after it has been annealed. We have made 4,500 wrenches during the past 18 months and they all seem to have given good satisfaction.

Fig. 13 shows dies for bending cellar bolts. These dies may be used on any power punch by having the plunger out far enough to clear the punch. With this tool a bolt may be bent at every stroke of the machine and the short ends can be worked up into cotter pins.

A power punch is a very valuable machine in a shop. The following is some of the work we perform with it: Bending grab-irons, sill steps, pin lifters, pipe clamps, corner bands, pin-lifter brackets, brake hangers, cellar bolts, calker pins, ladder uprights, running board brackets and brake step brackets.

During the past year 400,000 grabirons were forged in the shops at Sayre, Pa., the dies in Fig. 14 being used. These dies are placed in an old four-hammer bolt machine with the sides and bottom hammers removed. A shear blade is attached to the top hammer and a bottom shear blade is placed across for shearing off the burrs which are on the bottom of the foot as the hole is punched nearly through by a button on the header. A punch die is arranged in front of the shear blade and the punch is attached to an extension bar which is placed in the header holder. The button on the header saves nearly 90 ft. of iron in a thousand grabirons and the button serves as a gage when upsetting the second end. Two men will upset 6,430 ends complete in 10 hours. One man will punch and trim the burrs on 10,000 ends in 10 hours and one man will make a single bend under the punch of 9,000 ends in 10 hours.

H. E. Gamble, Pennsylvania Railroad: Steel plate for piling scrap has been a great success in the Juniata smith shop. We have been using this kink for about four years and the saving in the use of lumber has been worth while; also the amount of sand necessary to keep up the furnace bed has been reduced, as when wood was used for the piles it would burn up and produce rough spots or eat holes in the bed of the furnace, in which sand would have to be used freely, causing delay in charging up the next heat. The steel plate does not remain in the furnace longer than is required for the men to shove the pile of scrap on to the furnace bed. We use a plate 12 in. by 20 in. to form a bloom weighing from 500 lb. to 1,000 lb.

OTHER BUSINESS

Other papers were presented by Thomas F. Keane (Ramapo Iron Works) on Electric Welding, in which the various systems were thoroughly described, and by W. F. Stanton (J. A. Fay & Egan Company) on Making and Repairing Frogs and Crossings. The secretary reported a membership of 323.

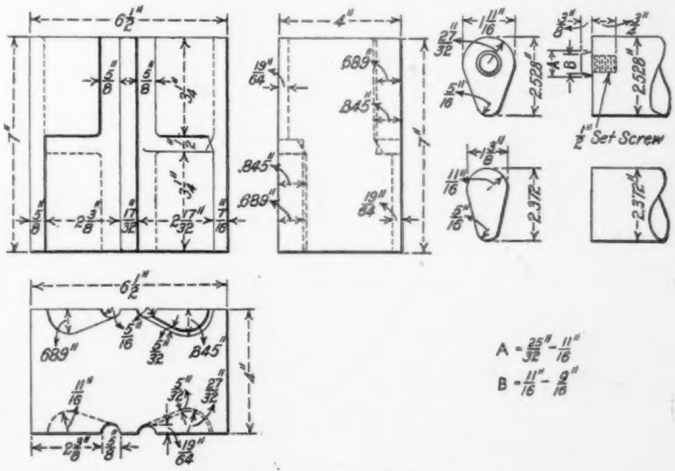


Fig. 14—Dies for Forging Grab Irons

The following officers were elected for the ensuing year: President, T. F. Buckley, Delaware, Lackawanna & Western; first vice-president, T. E. Williams, Chicago & North Western; second vice-president, W. C. Scofield, Illinois Central; secretary-treasurer, A. L. Woodworth, Cincinnati, Hamilton & Dayton; assistant secretary-treasurer, George P. White, Missouri, Kansas & Texas; chemist, G. H. Williams, Boston, Mass.

Philadelphia received the greatest number of votes for the next convention. After the adjournment of the convention the members visited the Milwaukee shops of the Chicago, Milwaukee & St. Paul, and the shops of the Allis-Chalmers Manufacturing Company.

Invention of Logarithms.—The three-hundredth anniversary of the invention of logarithms by John Napier is to be celebrated this year.

GOGGLES IN RAILROAD SHOPS

One of the frequently recurring classes of injury to which railway shop employees are subjected is injury to the eyes by flying particles or chips of metal. Thousands of such injuries have occurred annually, some of them resulting in loss of sight, and many in entire loss of the eye. The use of goggles as a means of eye protection has been made a part of the safety campaigns of a number of railroads and, as is generally the case with safety movements, considerable effort has been necessary to secure effective co-operation on the part of the persons concerned.

On the New York Central Lines the use of goggles by employees who are doing work which is hazardous to the eyes has proved so effective that a campaign of education has been inaugurated by the general safety agent, in an effort to get every employee doing such work to use this means of eye protection at all times. During the year 1913 2,499 employees received eye injuries, practically all of which it is believed could have been prevented by the use of goggles. There has not been a case since their introduction where injury has been sustained from splintered glass, and several instances are reported where goggles not only saved the sight of an eye, but where the eye was undoubtedly saved from being gouged out by a flying piece of steel.

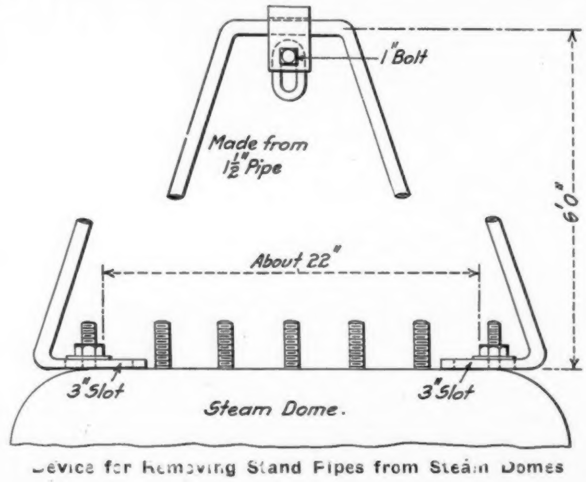
The goggles furnished by the company are known as the Saniglas, the lenses of which are of a specially ground clear glass which does not break except under an extraordinary blow. Each employee whose eyes are endangered by the class of work to which he is assigned is provided by his foreman with a fitted pair for his individual use. In order to impress upon the men the necessity of always wearing them when at work, the bulletin shown in the illustration has recently been placed in the principal shops of the system. It shows in a striking manner the protection afforded by the goggles. An illustrated circular has also been distributed to all shop employees. This is printed in four languages: English, German, Polish and Italian, and gives a number of concrete examples with illustrations emphasizing the risks taken when working with the eyes unprotected.

REMOVING STAND PIPES

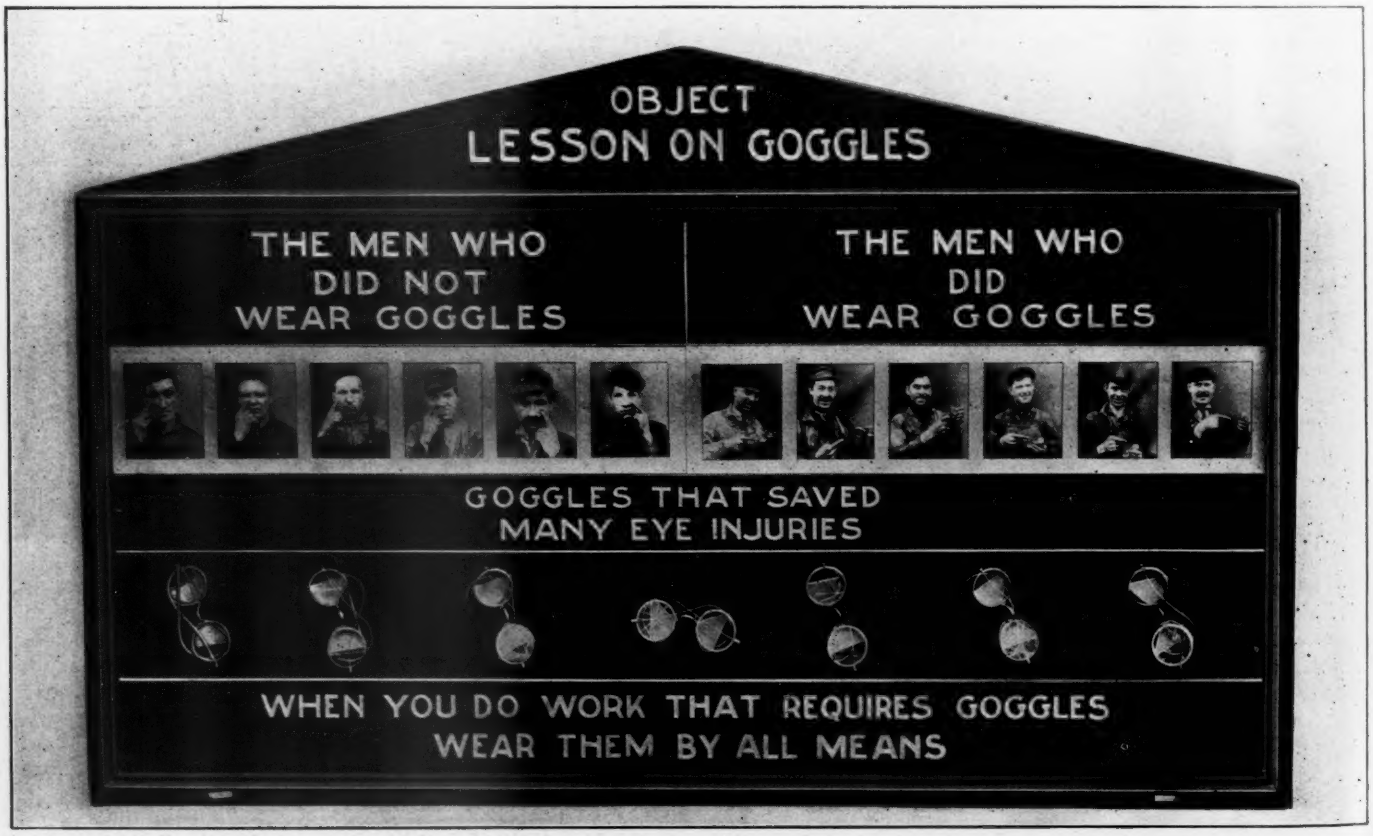
BY R. F. CALVERT

The accompanying sketch shows a device used at the Horton, Kan., shops of the Rock Island lines for handling stand pipes when stripping and erecting engines under general repairs.

This device is made from an old piece of $1\frac{1}{2}$ in. gas pipe. The two ends as shown in the illustration are flattened and slotted for about 3 in. to accommodate the variety of sizes of steam domes. The pipe is bent to the shape shown and a 3 in. eye bolt fastened to the top for use with a rope fall or chain hoist. It was thought at first that some means of staying would have to be provided, but after the attachment had been used a few times this was found unnecessary if care was taken to select two dome studs diametrically opposite each other. The upper half is guided by the guide pins shown. While the staff is being held tight the machine is started and the two punches *B* and *C* punch the holes, the end being sheared by the blade *E*.



Device for Removing Stand Pipes from Steam Domes



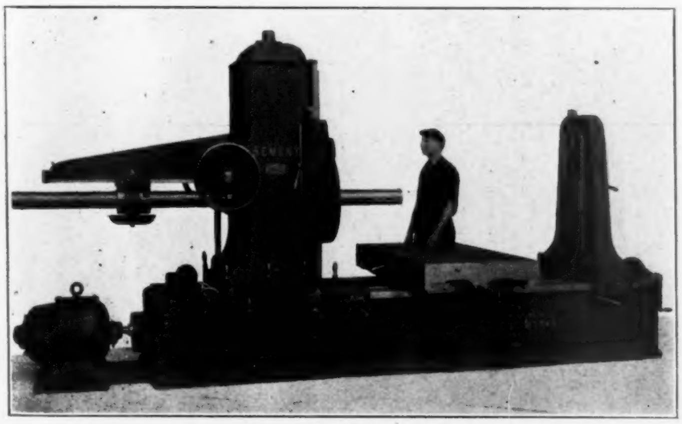
Goggles as a Means of Eye Protection on the New York Central Lines

NEW DEVICES

HORIZONTAL BORING, DRILLING AND MILLING MACHINE

A horizontal boring, drilling and milling machine with duplex control throughout has been developed by the Niles-Bement-Pond Company, New York. This machine is of the elevating spindle type, and as shown in the illustrations, is symmetrical throughout with respect to the spindle axis, permitting the operator to stand on either side and have all controlling levers within convenient reach. It is adapted for work requiring great accuracy, but the design being free from delicate parts, it is equally suitable for heavy boring service.

One of the important features of this machine is the location of the spindle saddle within the post. This makes possible the symmetrical construction of the entire machine about the spindle



Horizontal Boring, Drilling and Milling Machine

axis and affords a very rigid support for the spindle. The thrust is taken on two V tracks, one on either side of the spindle, eliminating the distorting strains which are inevitable in machines having the spindle and saddle on the front of the post. The thrust, coming squarely against the bearing of the saddle on the post, tends to add to the truth of the alinement. The saddle has a vertical power feed for milling as well as a rapid power traverse. This motion is transmitted through a vertical screw which is connected by gearing to a similar screw in the outboard post, so that the spindle saddle and outer bearing always move in unison. The spindle driving gear is enclosed within the saddle with a portion extending outward and exposed for use as a face plate.

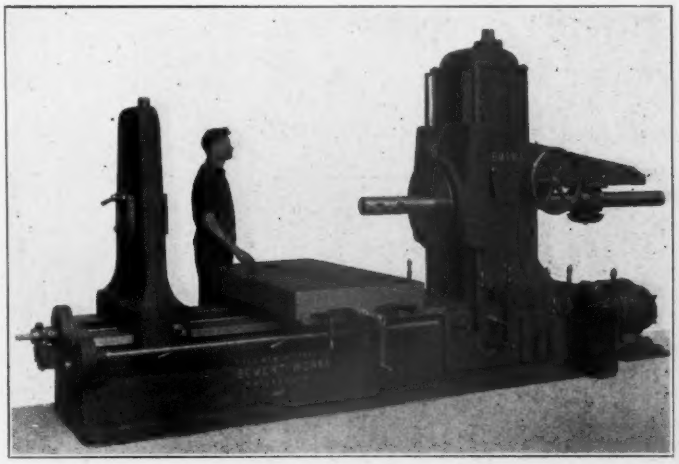
The spindle slides in a long sleeve which revolves in removable bearings, the main bearing being tapered so that adjustment may be made for wear. The spindle is driven through two large spline keys set into the sleeve and engaging keyways in the spindle. It is fed and rapidly traversed by means of a screw in the saddle horn.

The spindle column is of box form, open through the center but connected at the bottom in one continuous casting. It is closed at the top by a cap tongued and grooved into the two sides, thus making a very rigid structure. It is strengthened inside by ribs located in the best manner for resisting backward and torsional strains. The V tracks for the saddle traverse on the front of the column have unequal sides. The faces toward the outside of the column are broad, presenting a liberal bearing surface against the thrust of the saddle while the faces toward the inside are at approximately right angles to the others for resisting side thrust.

The outboard column is made in two parts; the lower portion is gibbed to the bed and has longitudinal adjustment; the upper portion is bolted and doweled to the lower so that it may be removed for long pieces of work and easily replaced in correct alinement. Provision is made for disconnecting the vertical lifting screw from its operating mechanism in order that dismantling any part of the gearing may be unnecessary when the post is removed.

The table has a very large working surface with T-slots for holding the work. It is gibbed to a broad saddle large enough to support it at the extreme position of its travel. The saddle is adjustable along the bed by hand or by power through a screw running between the tracks of the bed. The bearings of the table on the saddle and those of the saddle on the bed are both gibbed with square locks in which provision has been made for adjustment for wear. The table is provided with power cross feed for milling and rapid power traverse for quick adjustment.

The bed has an unusually wide top, presenting a liberal surface for the table saddle bearing. It has broad flanges at the bottom and is braced inside with frequent cross ribs. The top is entirely closed to prevent chips from falling inside. Within the table are the driving, feed and traverse gears. The driving gears run in an oil bath and the feed and traverse gears are lubricated by the splash system. Large cover plates on both sides of the bed provide a means of ready access to the gearing for examination. Power feeds are provided as follows: Horizontal feed of the spindle for boring and drilling; vertical feed of the spindle saddle and cross feed of the table for milling. An



Duplex Control Symmetrically Arranged About the Spindle Axis

automatic feed may also be provided for circular motion of the standard table or in connection with a round table. All feeds are reversible and are not affected in amount per revolution by changes in the spindle speed.

An auxiliary work support, consisting of a narrow casting extending across the bed, is furnished if required. It has adjustment on the bed and is of the same height as the regular work table. It is provided with a T-slot in the top surface for clamping the work. A facing head has also been designed which may be attached either to the face plate gear or to the boring bar. It is provided with automatic radial feeds by adjustable fingers and star wheel. The machine may be driven by variable speed direct current motor, cone pulley and countershaft, single pulley and speed box, multi-speed alternating current motor or constant speed alternating current motor and speed box. Where

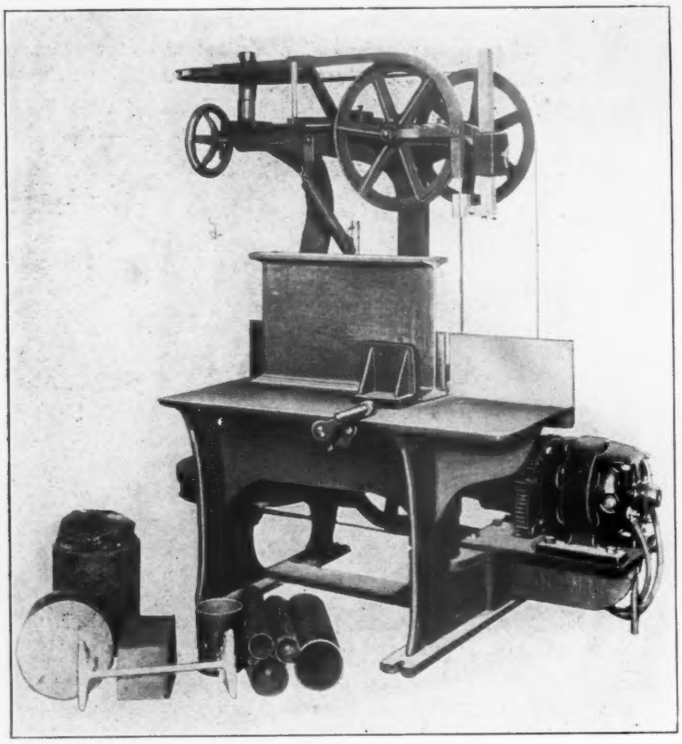
possible to use a direct current motor with a variable speed range of three to one this drive is considered preferable by the manufacturer.

BAND SAW FOR CUTTING METAL

A metal band saw has recently been developed by H. C. Williamson, 1840 West Lake street, Chicago, which is adapted to a wide range of cutting-off operations. It will cut off any size stock up to 10 in. in diameter and is shown in the illustration with a 12 in. I-beam in position, which, it is claimed, it will handle without difficulty.

The table is 20 in. high and a number of holes are drilled and tapped in the surface for use in attaching clamps to special work. It has been kept as low as possible in order to facilitate the handling of heavy pieces. For handling bars or tubes the table is equipped with a back and vise jaw by means of which the work is readily clamped in position. A swivel back and vise is also furnished for cutting at any angle.

The saw is carried by flanged pulleys which are attached to a swinging frame back of the table. This frame is pivoted about the driving shaft at the base of the machine. The saw is driven by a 24-tooth pinion on the driving shaft, which meshes with a 96-tooth bevel gear, the rim of which forms the lower pulley about which the saw passes. The arrangement of pulleys is such that the saw returns at the rear of the table, thus making it possible to handle stock of any length. A handwheel adjustment is provided at the top of the swinging frame by means of which the tension on the saw is regulated. In operating the machine after the work has been clamped to the table the swinging frame is tilted forward by means of a handle at the top until the saw begins to cut; it then feeds by gravity without further attention from the operator. An automatic stop is provided by means of which the power is shut off when the saw has finished cutting.

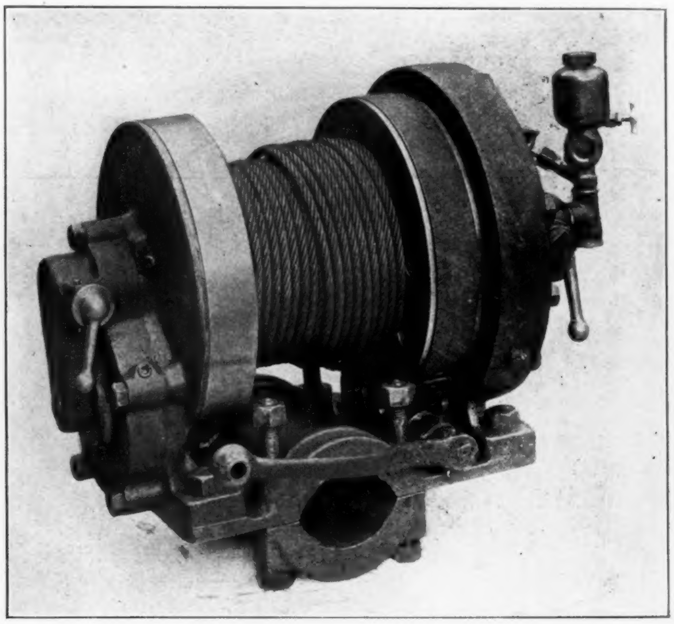


Motor Driven Metal Cutting Band Saw

It is claimed that in cutting off tubes, which cause considerable trouble by breaking the teeth when a hack saw is used, the band saw causes little trouble because of its continuous motion and uniform feed. The time required to cut off a 5 in. superheater tube is claimed to be two minutes, while a 3 in. round bar requires seven minutes, this time being slightly increased as the saw becomes dull. The operation of this machine requires about ½ h. p.

PORTABLE STEAM OR AIR HOIST

A small hoist which has a lifting capacity of 1,000 lb. has recently been brought out by the Ingersoll-Rand Company, 11 Broadway, New York City. Due to its light weight, which is under 300 lb. complete, it is particularly suitable for light lifting service wherever a portable hoist is required. In manufacturing and power plants it is very handy for moving light machinery, for hoisting ashes and other waste material, for loading trucks, etc. It is particularly suited for service in foundries in lifting flasks and ladles. In ship yards, railroad shops and on construction work it can be put to a variety of uses.



Portable Hoist for Attachment to a Column or a Timber Foundation

The base is arranged so that it may be bolted to a timber foundation or clamped to a circular member such as a column, shaft bar or pipe, to which it may be quickly attached. The dimensions of the hoist are 21¼ in. by 16½ in., the height being 20⅛ in. The drum is 6 in. in diameter with a space between flanges of 7 in. This will accommodate 700 ft. of ¼ in. rope or 450 ft. of 5/16 in. rope. The capacity of 1,000 lb. is obtained at a rope speed of 85 ft. per minute and a steam or air pressure of 80 lb. per sq. in.

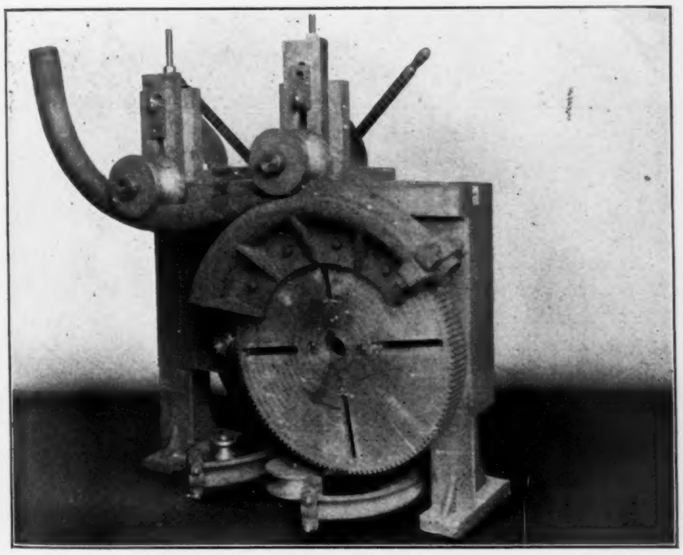
The motor is of the reversible square piston type giving four impulses per revolution of the engine. There are no dead centers and the hoist will start in any position. The drum is mounted independent of the motor shaft and is operated through a clutch and gears. Safety is provided by a powerful worm-operated band brake lined with Raybestos. The front of the hoist is shown in the illustration. The motor is on the right hand side adjacent to which is the band brake. The gear case is on the left hand side, the gears and clutch being controlled by the lever shown on the gear case. The throttle lever at the right controls both the speed and direction of operation and when released it returns automatically to the central position, thus shutting off the power

and stopping the hoist. The brake is operated by the long lever shown at the bottom.

All moving parts with the exception of the drum are enclosed, thus insuring against accidents to workmen who would otherwise be in constant danger of catching their clothing in the gears.

PIPE BENDING MACHINE

The frequent demand for a machine to bend large pipe has led to the development by the Pedrick Tool & Machine Company, Philadelphia, Pa., of the machine shown in the illustration. This is similar in construction to those designed by the same company for pipes of small size, some modifications being made to secure the increased strength required. The main frame is a rectangular casting ribbed on one side and provided with large bosses where the gear shaft passes through. The gears are machine cut, of heavy pitch, and have wide faces. The ratio is ample to permit the use of hand power. One end of the pipe to be bent is clamped in position at the end of a quadrant of



Machine for Bending Large Pipe

the desired radius, which is attached to the face plate. Two rollers which are adjustable both laterally and vertically are secured to the frame of the machine. These may be brought to bear on the pipe at any desired points.

It is claimed that with this machine two men can easily put right angle bends in pipe 4 in. in diameter, the work being done with the pipe cold and unfilled. The illustration shows a 4 in. pipe in the machine bent on an 18½ in. radius, which is smaller than usually called for in practice. The bends made by this machine are smooth and round, and are claimed to be satisfactory in every way.

DUNTLEY ELECTRIC DRILL USED ON RADIAL DRILL.—The Chicago Pneumatic Tool Company, Chicago, reports a new application of its Duntley electric drill. It is provided with a Morse taper shank so that it may be used in an ordinary radial drill, and will be of particular value when it is necessary to drill small holes in large castings that also require large holes. Instead of using the radial drill and running it at a high speed for the small drills the electric drill may be inserted in the spindle of the machine and operated under its own power, thereby saving the wear and tear on the more expensive machine. Both the longitudinal and vertical feed of the radial drill may be used to advantage in spotting and drilling the holes with the small electric drill.

MONORAIL SYSTEM WITH FIXED TONGUE TRACK SWITCHES

A wider application of the overhead monorail system to the requirements of inter-shop transportation, coal and ash handling and similar service has been brought about by the recent development of an electric monorail system with fixed tongue track switches, which has been made by the Shaw Electric Crane Company, Muskegon, Mich. A typical two-motor monorail hoist of this type is shown in one of the illustrations.

The ordinary form of monorail track switch is a hinged section of the runway girder, engaging the main and spur tracks, and the limitations inherent in this switch tend to restrict the application of the overhead monorail system. The distinctive feature of the Shaw Monorail System is the absence of any moving part in the track switch, which somewhat resembles a

Fig. 1—Two-Motor Monorail Hoist Operating on Track System with Fixed Tongue Switches

frog in appearance and operation. The operator in the cab has independent and absolute control, both of the route and the hoisting and travel operations. The hoist may be run through the switches in all directions without stopping, the operator selecting his route while in motion. There are no open ends of the track to be protected, and it is therefore impossible for the trolley to break through and fall to the ground. The illustration of the cast-steel track switch, Fig. 2, shows clearly the two slots through which the truck sides pass, the left side through slot *A* when the trucks run through the switch, and the right side through slot *B* when diverted to the spur track. In either case the truck wheels run over the gaps, but the wheel-base of the truck is so proportioned that three wheels always ride on the runway flanges, and the wheels bridge the gaps at such an angle that the break is only nominal.

The manner in which the leading truck is steered onto the spur track is shown in Fig. 3, which is a sectional plan at the level of the lower flanges of the I-beam track, showing a right hand switch and the truck sides of the trolley. When approach-

ing the track switch with the intention of running onto the spur, the horizontal roller $T2$ located in the front of the leading truck, is raised by the steering lever in the cage and engages the curved flange S on the underside of the central tongue of the switch. The advance end of the flange is shown in the illustration of the switch, Fig. 2.

In this manner the leading truck is swiveled and diverted to the spur track. No steering operation is necessary to return from the spur to the main track nor to run through the track switch in either direction on the main line.

The method by which the trailing truck is compelled to follow so that the trolley cannot split the switch, is shown in Fig. 4. The smaller diagram is an enlarged sectional plan showing the rear

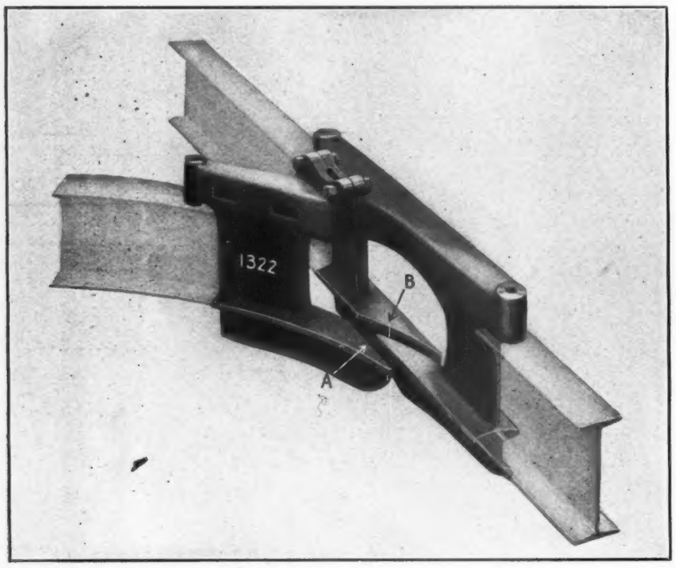


Fig. 2—Cast Steel Track Switch

truck frame and a portion of the trolley frame which joins the two trucks and supports the hoisting machinery, taken at the level of the trolley frame. Lines L, R and F represent the center lines respectively of the leading truck, the rear truck and the trolley frame. The trucks swivel on the trolley frame through angle A, which is limited by an adjustable set screw $S1$ in truck side $R1$.

Assuming both trucks to be on the main track and approaching the switch, center lines L, R and F then lie in the same vertical plane and the angle A is zero. As the leading truck proceeds around the curve of the spur, the trolley frame swings around with reference to the center line R of the rear truck, and the angle A increases. When the rear truck reaches the point where the curve begins, as shown in the engraving, the

length of arc whose chord is the center line F, as this arc determines the angle A for which the set screw $S1$ is adjusted; beyond this arc any longer radius may be employed. Set screw $S2$ in the truck side $R2$ provides for similar operation on left hand switches. Both trucks embody the steering feature and the

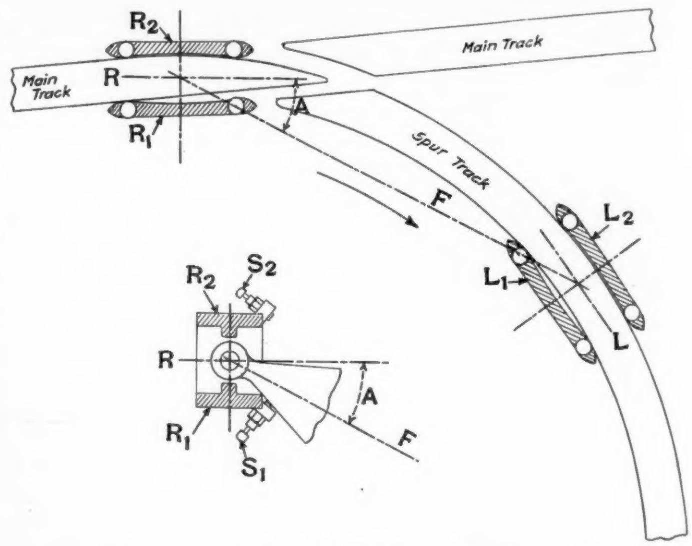


Fig. 4—Means by which the Rear Truck is Automatically Compelled to Follow Through the Switch

set screw adjustment, so that operation in both directions is identical.

Several installations of this monorail system are reported to be in successful operation, the capacities ranging from two to six tons. The hoist is built either with the single lift as shown, or with a double hoist for handling the ordinary two-line clamshell bucket, two separated holding lines being employed to prevent swiveling of the bucket.

A PROCESS OF CASEHARDENING WITH GAS

A process of casehardening in which gas is used as the carbonizing agent has recently been developed by the American Gas Furnace Company, 24 John street, New York. The process is performed in a slowly revolving cylindrical retort into which the carbonizing gas is injected under pressure. From this gas the work absorbs volatile carbon, arrangements being provided for venting the waste gas as required to insure a maximum speed of carbon penetration.

The drawing shows a longitudinal sectional elevation of a gas

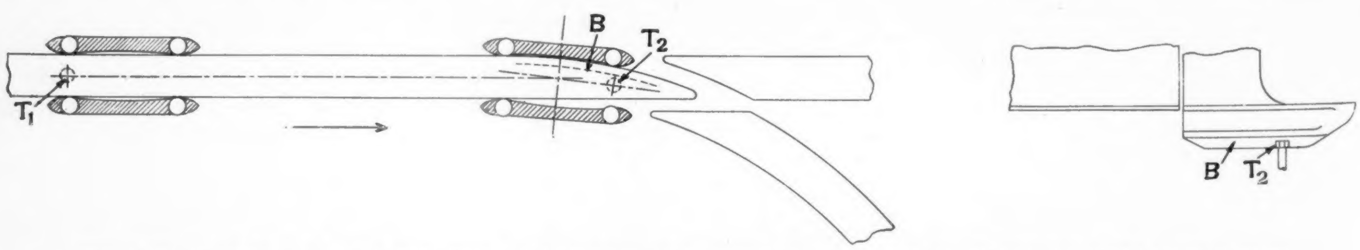


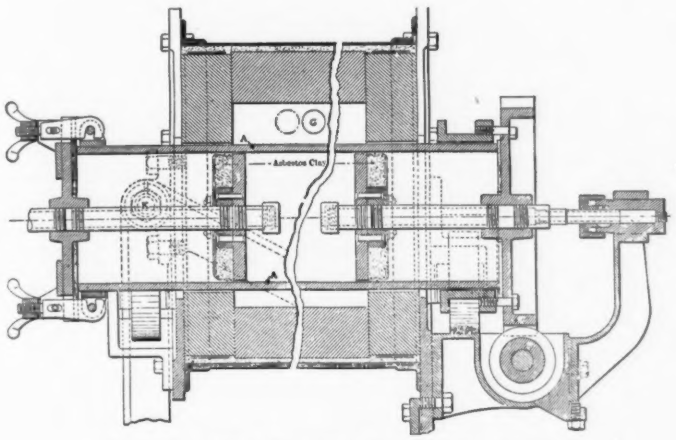
Fig. 3—Section Through Truck Side Frames at the Lower Flange of the Track I-Beam, Showing a Right-Hand Switch

set screw $S1$ engages the frame casting and angle A has attained its maximum value; as the trolley proceeds beyond the position shown, the frame casting slews the rear truck around and compels it to follow to the spur track. It should be noted that this operation is automatic, and entirely independent of the initial steering operation. The only essential condition is that all curves on the same track system have the same radius for a

carbonizing furnace. The heavy wrought iron retort A is surrounded by a cylindrical furnace body, within which it is rotated on rollers attached to the ends of the furnace. The work is confined within the retort between two pistons, large air spaces being provided between the pistons and the ends of the retort. The carbonizing gas is admitted through one piston and the waste gas vented through the other.

A complete plant consisting of a carbon gas producer and two furnaces is shown in the illustration. The furnaces are supported by trunnions; and the pipe connections to the furnace and retort, together with the chain and sprockets by means of which the retort is revolved, are so arranged that the furnace may be tilted for convenience in filling and emptying without disconnecting the pipes or the driving mechanism.

The generator supplies gas made up of carbon vapor derived

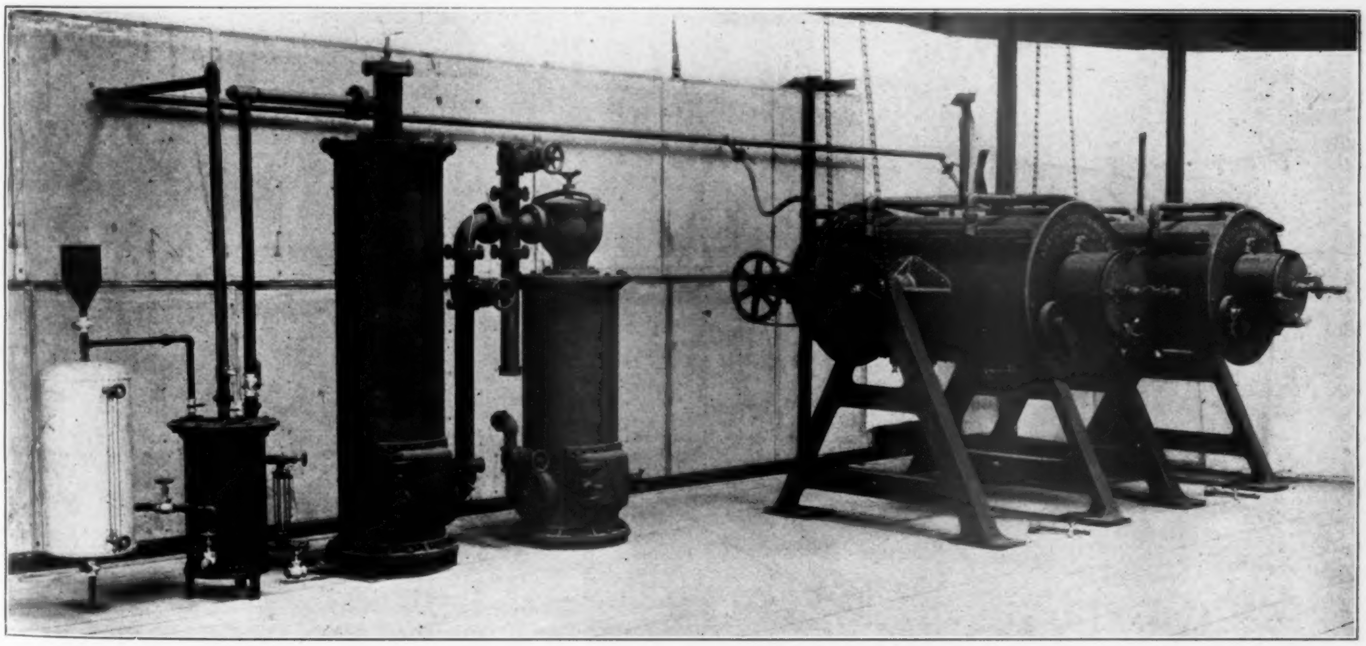


Sectional View Through Carbonizing Furnace

from refined petroleum and a neutral gas, combined in such proportions that the absorption of carbon by the work will take place without the formation of obstructing carbon deposits. Each generator has a capacity sufficient to supply two machines of the type illustrated. In many cases it is possible to use ordinary illuminating gas as the carbonizing agent, thus dispensing with the generator. Whether or not this can be done depends upon the gas available, which must be low in sulphur.

By the use of gas the process of carbonizing may be performed with much greater uniformity than is possible where the work is packed in solid carbon. All parts of each piece and all pieces included in a charge are subjected to exactly the same treatment, thus assuring uniformity in the depth of penetration. Owing to the low heat conductivity of the various solid materials used as carbonizing agents, work near the outside of the retort will be subjected to the carbonizing temperature for a greater length of time than work near the center. Volatile carbon finds its way into slots, holes and cavities into which sufficient solid material to produce the desired penetration could not be packed. There is also a saving in time due to the shorter period required to heat the volatile carbon retort to the temperature at which carbon is absorbed.

Each machine of the size shown in the illustration is claimed to require for fuel 400 cu. ft. of illuminating gas, or its heating equivalent, per hour, carbonizing gas being furnished at a cost of about 10 cents per hour. The retort requires renewal at a cost of $48 after a service of about 400 hours.



Complete Carbonizing Plant, Made Up of Gas Producer and Two Furnaces

SERVICE RECORDS OF CHROME-VANADIUM ROLLED STEEL TENDER WHEELS

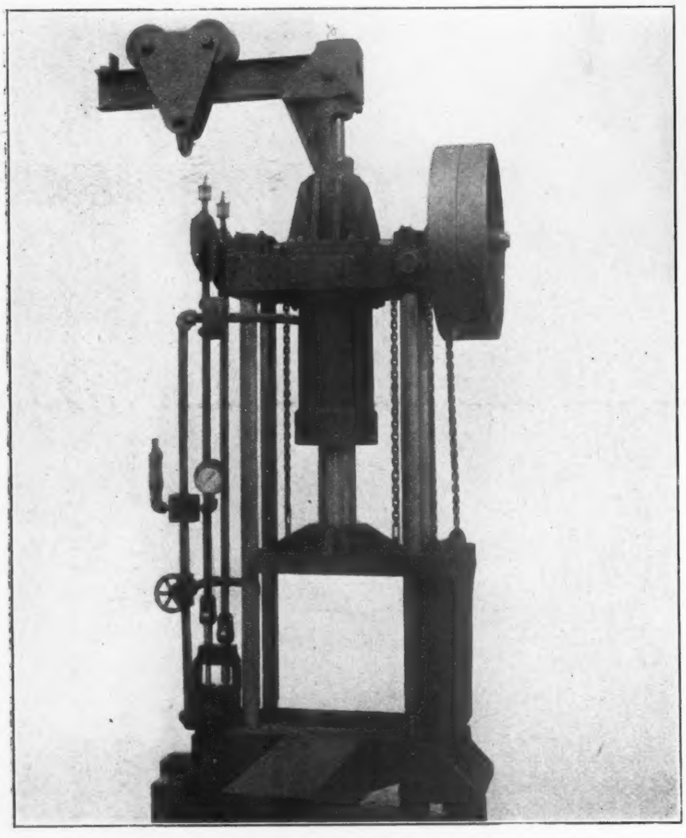
In order that the relative merits of various types of tender wheels might be definitely determined, three successive lots of Mikados purchased by the Grand Trunk during the past year and a half have each been equipped with different types. The tenders of these engines have a capacity of 9,000 gal. of water and 15 tons of coal; they have a total weight in working order of 172,100 lb., and a load per wheel at the rail of 21,525 lb. There were 25 engines in each lot, the tenders of the first lot being equipped with untreated carbon steel tired wheels, the second lot with oil treated rolled wheels of carbon steel, and the third lot with oil treated rolled wheels of chrome-vanadium steel. Both the rolled wheels of carbon and chrome-vanadium steel were made by the Standard Steel Works Company. One of the serious problems of locomotive maintenance with which the Grand Trunk has to contend is the large amount of shelling of wheels and tires during the severe cold of the winter months. The conditions under which the test was conducted afforded an opportunity to make a thorough comparison of the advantages of the three types of wheels in this respect. The steel tired wheels entered service during a period from late in January to the early part of March, 1913. The oiled treated carbon steel wheels entered service in August and September, 1913, and the vanadium steel wheels during November of the same year. Although the steel tired wheels were in service during a longer period than either of the two types of rolled wheels they saw little service during the winter of 1913, and their service during the severe

cold of the past winter is considered as the real test of their ability to withstand shelling. All cases of shelling on these wheels occurred during the past winter.

The records from the date the first lot of Mikados entered service, until May 1, 1914, show that during this period three pairs, or 3 per cent of the chrome-vanadium steel wheels had been removed on account of shelling, while nine pairs, or 9 per cent of carbon steel wheels and 17 pairs, or 17 per cent of the steel tired wheels had been removed from the same cause. Further comparison showed that a total of 8 per cent of the vanadium steel wheels, 22 per cent of the carbon steel wheels and 52 per cent of the steel tired wheels had to be removed from all causes, including sharp flanges and tread wear. Owing .he longer service of the steel tired wheels, however, which accounts for the larger number of renewals due to tread and flange wear, no comparison is justified except as to the shelling out of the treads.

HYDRAULIC BUSHING PRESS

The hydraulic press shown in the illustration is designed especially for use in railroad shops for pressing on and off bushings and is built by R. D. Wood & Company, Philadelphia, Pa. It is operated by a belt driven double plunger pump and is equipped with a release valve, safety valve and pressure gage. The pump valve is made of a solid steel forging which is bored out and fitted with bronze valves and



Hydraulic Bushing Press with Capacities Up to 150 Tons

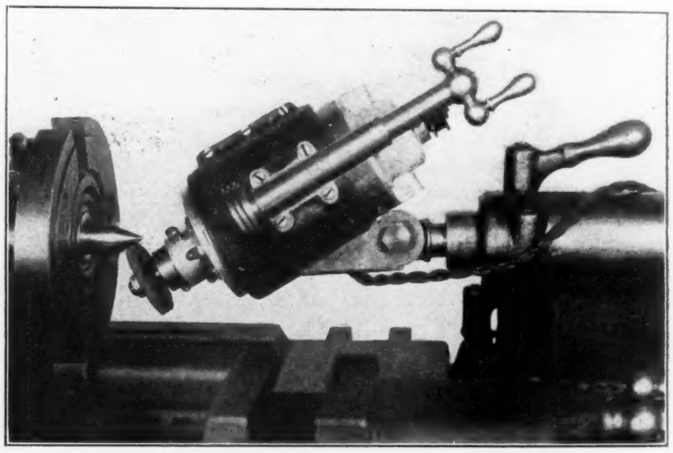
seats. The press cylinder is made of open hearth steel and is fitted with a semi-steel ram provided with cupped leather packing. The ram is counterbalanced and is guided by the four columns which form the frame of the press. At the top of the press is a short crane, shown in the illustration, which is provided with a trolley for handling heavy work. This is not regularly provided, but can be furnished if ordered.

Presses of this type are built in capacities ranging from 30 tons to 150 tons. The diameter and stroke of the ram for the various capacities range from 6 in. by 14 in. to 9 in. by 24 in. This press has been developed to meet the demand for increased capacity and a number have been installed with a capacity of 100 tons for handling bushings, crown brasses and similar work.

ELECTRIC LATHE CENTER GRINDER

The usual method followed in truing up lathe centers is to grind the center while revolving in the spindle, by means of a tool post grinder mounted upon the carriage of the lathe. After having secured the axis of the grinder at the proper angle with the axis of the lathe spindle it usually requires several trials before an adjustment of the grinder is secured in which its spindle and the lathe spindle are brought into the same plane. Until this adjustment is secured the spindle cannot be ground accurately to a 60 deg. angle, but will have a curved surface.

The portable electric grinder shown in the illustration has been developed by the Neil & Smith Electric Tool Company,



Grinder Centered in the Tailstock of a Lathe

Cincinnati, Ohio, to overcome the difficulties arising from the necessity of this adjustment. Instead of attaching this grinder to the tool post it is supplied with a taper shank which is inserted in the tailstock of the lathe in place of the regular dead center. Since the axis of the spindle in the grinder and the axis of the taper shank intersect, the grinder is at once in the proper position to grind a 60 deg. angle on the center in the headstock and no adjustment is required by the operator. In order that the grinder may be interchangeable on different size lathes a number of taper shanks are furnished, corresponding to the various size groups of lathes, all of which are secured to the grinder by a standard shank fitted to the grinder body. The grinder weighs about 18 lb. and is designed for operation on a 110 volt circuit at a speed of about 6,000 revolutions per minute.

Making Tracings Without Ink.—A drafting fabric has been put on the market by the Universal Drafting Machine Company, Cleveland, Ohio, to permit of making blue prints from original drawings without requiring the use of ink or pencil. The fabric is a cloth covered with a thin skin of hard brown material, and drawings are traced on it by means of a beveled steel point or scriber. Corrections may be made by means of an ordinary steel pen and ink. Lines may then be drawn through the corrections. It is also easy to change a full line to a dotted line by filling in the spaces with ink. The steel point used may be inserted in a compass when it is required to do circular work. Blue prints made in the ordinary way give, of course, dark lines on a white ground.—*The Iron Age*

NEWS DEPARTMENT

On Sunday, August 16, according to a press despatch, the sum of $25,000 was taken in by the government in the shape of tolls for the passage of vessels through the Panama Canal.

A standard dining car of the Chicago, Burlington & Quincy has been selected by the state pure food commissioner of Nebraska to demonstrate the proper method of serving food on dining cars, at the state fair to be held in Lincoln, September 7 to 11. All meals will be served to the fair visitors, who will be allowed to inspect the kitchen and see how the work is conducted.

The monorail street car line which was built in the northern part of New York City a few years ago appears, after many vicissitudes, at last to be dead. A new line of ordinary street cars, with storage battery motive power, was put in service August 18. The line is from the City Island station of the New York, New Haven & Hartford Railroad to Belden's Point, about 3 miles. The opening of the line followed the condemnation of the monorail as unsafe a few months ago.

The safety bureau of the El Paso & Southwestern has issued a circular showing the behavior of 3,607 automobiles and their drivers observed during the period of one week while crossing the tracks of the road in El Paso. It was found that 2,907, or 80 per cent of the drivers of these automobiles, did not look in either direction; 620, or 17 per cent looked only in one direction, and only 80, or 2 per cent, took the precaution to look both ways before crossing the tracks; while 296 of the number who looked in neither direction crossed at a speed greater than 20 miles an hour. And six of this number saw the flagman and crossed the tracks disregarding his signal.

In a paper on the Compound Articulated Locomotive, presented by Anatole Mallet, originator of the Mallet type of locomotive, before the Institution of Mechanical Engineers at the Paris meeting, held in July, a method of comparing the weight of locomotives with the weight of rail was mentioned. Mr. Mallet showed that in 1829, engines weighing five tons ran on rails of 34.2 lb. per yard, which was equal to 327 times the weight of rail per yard. In 1846, engines weighing 22 tons ran on rails of 70.52 lb. per yard, which is 700 times the weight of rail per yard. In 1880, 56-ton engines ran on rails of 84.6 lb. per yard, which is 1,480 times the weight of rail per yard. In 1911, engines weighing 96 tons ran on 96.77 lb. rails, which is 2,220 times the weight of rail per yard, and in the United States a Mallet engine with 10 coupled axles weighing 245 tons, adhesive weight, ran on 111 lb. rails, which is 4,950 times the weight of rail per yard.

SAFETY-FIRST PLACARDS

The Southern Pacific is posting in conspicuous places along its lines large placards displaying the following:

"We solicit your co-operation in preventing death and injury to yourself, our patrons and the community at large. Stop to look and listen before passing over railway grade crossings. Refrain from and discourage trespassing upon railroad property. Be careful when waiting for trains or using the company's facilities.

"It is not safe to start over a railway crossing without first stopping to look and listen, to get on or off trains while in motion to stand near edge of platform when trains are passing, to cross over ahead of an approaching train, or pass closely behind a train standing, to stand or walk upon tracks around stations or elsewhere, to allow children to play around the station, tracks and cars." Then follow some figures regarding trespassing and grade crossing accidents.

LOCOMOTIVE SMOKE IN CHICAGO

The method of controlling locomotive smoke in Chicago under the direction of the General Managers' Association has been referred to several times in these columns. That this arrangement has proved very successful is shown by the biennial returns made by the department of smoke inspection of the city. This summer's returns, including 9,453 observations, shows the best record for summer reading since the department was established. This year the average density is 6.304, as compared with 11.99 last summer. While the latest average is larger than that shown in the autumn of 1913 (5.79), it must be remembered that usually a great deal more smoke will be shown in the warm weather than in cold.

Out of seven reports this is the sixth in which the Chicago, Burlington & Quincy has maintained first place. The Burlington certainly is to be congratulated on the success it has attained, especially when it is considered that this road has a very large number of locomotives operating in the city. J. H. Lewis is chief inspector for the Burlington and also chairman of the Railroad Smoke Inspectors' Association, which reports to the General Managers' Association.

The roads in Chicago maintain 50 smoke inspectors, at a cost of about $65,000 per year in salaries, to keep locomotive smoke to a minimum. That this expenditure is warranted is shown by the smoke returns for the summer of 1914, as follows:

Railroad	Density, Summer, 1914	Density, Summer, 1913	Standing, Summer, 1913	Density, Autumn, 1913	Standing, Autumn, 1913
1—C. B. & Q.	1.63	7.74	5	1.64	1
2—Santa Fe	3.04	4.73	1	2.45	3
3—Northwestern	3.25	7.65	4	2.25	2
4—Lake Shore	3.75	9.49	6	2.76	4
5—Soo Line	3.94	10.86	7	13.54	27
6—C. G. W.	4.3	13.37	12	3.99	6
7—Mich. Cent.	4.39	12.23	11	6.32	13
8—Grand Trunk	4.68	16.62	23	4.89	9
9—St. Paul	4.81	11.75	8	3.64	5
10—Pennsylvania	5.15	16.58	22	7.89	22
11—C. & W. I.	5.32	17.1	25	6.61	15
12—C. & O.	5.5	14.78	17	4.	8
13—Illinois Cent.	5.5	7.43	3	3.99	7
14—B. & O. C. T.	6.14	12.14	10	7.23	21
15—N. Y. C. & St. L.	7.11	11.9	9	6.42	14
16—Rock Island	7.24	14.66	15	5.16	10
17—C. & E. I.	7.87	14.73	16	6.92	17
18—C. I. & S.	8.66	15.12	19	5.29	11
19—Wabash	9.81	14.12	14	7.19	19
20—C. & A.	11.31	16.56	21	6.84	16
21—Ill. Northern	11.54	6.31	2	6.03	12
22—Pere Marquette	12.04	18.8	28	7.19	20
23—B. & O.	12.12	13.4	13	12.41	25
24—Monon.	12.21	15.63	20	7.15	18
25—Belt	12.26	18.06	26	9.27	23
26—E. J. & E.	12.77	18.45	27	11.91	24
27—Erie	15.71	20.51	29	12.57	26
28—C. Junction	18.1	17.01	24	19.29	28
29—Pullman	26.49	Not listed		48.42	31
30—C. R. & I.	35.	14.94	18	41.46	30
31—C. Short Line	45.45	29.23	32	34.	29

PRIZES FOR AIR BRAKE STORIES

The sum of $2,000 in prizes has been offered by the Westinghouse Air Brake Company in several advertisements published in various technical papers during the last few months. The company stated that it would pay this sum for the six best stories submitted, under certain conditions, dealing with the experience and practical knowledge of railroad employees regarding any striking performance of the air brake manufactured by this

company. The history of braking railroad trains is full and complete in dramatic but unwritten narrative, and the company believes that by offering this incentive a vast amount of this material will be brought to light. The conditions stated that the story must be written either from the practical experience or the personal observation of the writer, or from information obtained first hand from railroad men who actually knew the facts related. The contest closed August 1, 1914, and the committee of judges, composed of the following men, is now engaged in judging the entries: W. E. Symons, consulting mechanical engineer, Chicago; Willard Smith, editor, Railway Review, Chicago; and Roy V. Wright, managing editor, Railway Age Gazette, New York City. Considerable interest was displayed in the contest, and a large number of stories submitted so that several weeks will elapse before the judges will be able to announce the winners of the prizes.

TOOL FOREMEN'S CONVENTION

In the remarks of E. J. McKernan, supervisor of tools of the Atchison, Topeka & Santa Fe at the Tool Foremen's convention, an abstract of which was published on page 425 of the August issue, the taper of 3 in. in 12 in. given for the reamer for the Stephenson valve gear should have been 3/8 in. in 12 in.

A CORRECTION

On page 315 of the June, 1914, issue the reference in the paragraph near the bottom of the last column to the voltage used in electric welding outfits should have been to current, in amperes; and on page 318 in the reference to radial stays, the taper of 3/4 in. in 1 1/2 in. should have been 1/4 in.

MEETINGS AND CONVENTIONS

Master Car and Locomotive Painters' Association.—The forty-fifth annual convention of the Master Car and Locomotive Painters' Association will be held at the Hotel Hermitage, Nashville, Tenn., September 8 to 11, inclusive. The subjects to be considered are: Finishing Steel Passenger Equipment; Rust Inhibitive Paint for Steel Freight Cars; Shop Practice in Finishing New Interior Wood Finish of Passenger Coaches; Locomotive Tender Varnishes; Classification of Interior and Exterior Repairs of Passenger Cars; Apprentice System in the Paint Shop; Results of the Sand Blast as a Paint Remover; Standard Freight Car Lettering, and Blister-proof Paint for Locomotives. A. P. Dane, Reading, Mass., is secretary.

American Foundrymen's Association and American Institute of Metals.—The American Foundrymen's Association and the American Institute of Metals will hold their annual conventions at the LaSalle hotel, Chicago, September 7-11. In connection with these conventions the Foundry & Machine Exhibition Company will conduct its annual exhibit from September 5 to 11, inclusive, at the International Amphitheater located at the Stock Yards in Chicago. This exhibit will include many articles of interest to railroad men. A review of the list of the 164 exhibitors discloses the fact that 50 per cent of them handle railway supplies. About forty of these are prominent builders of modern machine tools that are in every-day use in railway shops. Others represent shop accessories, such as pneumatic tools, grinding machines and abrasives, cranes, hoists and other shop fixtures that are no less important. The oxy-acetylene and electric welding companies will be represented with working demonstrations of their systems as will also the Goldschmidt Thermit Company. Railway men who can take the time to attend this exhibit will find it very well spent.

Traveling Engineers' Association.—The twenty-second annual convention will be held at the Hotel Sherman, Chicago, Ill., commencing at 10 a. m., Tuesday, September 15, and continuing four days. The subjects to be discussed are as follows: Difficulties accompanying prevention of dense black smoke and its relation to cost of fuel and locomotive repairs; Martin Whalen, chairman. Operation of all locomotives with a view of obtaining maximum efficiency at lowest cost; J. R. Scott, chairman. Advantage to be derived from the use of mechanical stokers, considering (first) increased efficiency of the locomotive; (second) increasing the possibility of securing a higher type of candidates for the position of firemen; (third) the utilization of cheaper grades of fuel; J. H. DeSalis, chairman. The care of locomotive brake equipment on line of road and at terminals; also, methods of locating and reporting defects; Geo. H. Wood, chairman. Advantage derived from the use of speed recorders and their influence on operating expense; Fred Kerby, chairman. Practical chemistry of combustion; A. G. Kinyon. Scientific train loading; tonnage rating; the best method to obtain maximum tonnage haul for the engine over the entire division, taking into consideration the grades at different points on the division; O. S. Beyer, Jr.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass. Convention, May 5-7, 1915, Hotel Sherman, Chicago.

AMERICAN RAILWAY MASTER MECHANICS' ASSOC.—J. W. Taylor, Karpen building, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—Owen D. Kinsey, Illinois Central, Chicago. Convention, July, 1915, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Convention, December 1-4, 1914, New York.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, except July and August, Lytton building, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—S. Skidmore, 946 Richmond street, Cincinnati, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. G. Hall, 922 McCormick building, Chicago. Convention, May 17-20, 1915, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 914 W. Broadway, Winona, Minn. Convention, July, 1915.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen building, Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOC. OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass. Convention, September 8-11, 1914, Nashville, Tenn.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—E. Frankenberger, 623 Brisbane building, Buffalo, N. Y. Meetings monthly.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y. Convention, September 15, 16, 17 and 18, 1914, Hotel Sherman, Chicago, Ill.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Sept. 8	....	....	James Powell	Room 13, Windsor Hotel, Montreal.
Central	Sept. 11	Brick Arches	George Wagstaff	H. D. Vought	95 Liberty St., New York City.
New England	Sept. 8	....	....	Wm. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Sept. 18	Handling Miscellaneous Freight at Boston	Dr. Harold Pender	H. D. Vought	95 Liberty St., New York City.
Pittsburgh	Sept. 25	Government Regulation of Railway Operation	Samuel O. Dunn	J. B. Anderson	207 Penn. Station, Pittsburgh, Pa.
Richmond	Sept. 14	....	....	F. O. Robinson	C. & O. Ry., Richmond, Va.
St. Louis	Sept. 11	....	....	B. W. Frauenthal	Union Station, St. Louis, Mo.
Southern & S'w'rn	Sept. 17	....	....	A. J. Merrill	218 Grant Bldg., Atlanta, Ga.
Western	Sept. 15	....	....	Jos. W. Taylor	1112 Karpen Bldg., Chicago, Ill.

Personals

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL

Morgan K. Barnum, general mechanical inspector of the Baltimore & Ohio, at Baltimore, Md., has been appointed superintendent of motive power of the Baltimore & Ohio proper, with office at Baltimore. Mr. Barnum was born on April 6, 1861, and was graduated from Syracuse University in 1884 with the degree of A. B., and later received the degree of A. M. He began railway work in 1884 as a special apprentice in the shops of the New York, Lake Erie & Western, now the Erie, at Susquehanna, Pa. He was then consecutively machinist and mechanical inspector, and later general foreman of the same road at Salamanca, N. Y.; general foreman of the Louisville & Nashville shops at New Decatur, Ala.; assistant master mechanic of the Atchison, Topeka & Santa Fe, at Argentine, Kan.; superintendent of shops at Cheyenne, Wyo.; district foreman at North Platte, Neb., and then division master mechanic at Omaha, Neb., on the Union Pacific; assistant mechanical superintendent of the Southern Railway. In February, 1903, he was made superintendent of motive power of the Chicago, Rock Island & Pacific, and in April of the following year was appointed mechanical expert of the Chicago, Burlington & Quincy; in 1907 he was appointed general inspector of machinery and equipment of the same road. He left that road in April, 1910, to become general superintendent of motive power of the Illinois Central and the Yazoo & Mississippi Valley, remaining in that position until July 1, 1913, when he became general mechanical inspector of the Baltimore & Ohio, and now becomes superintendent of motive power of the same road. He was president of the Master Car Builders' Association in 1913-14.

M. K. Barnum

Joseph Billingham has been appointed superintendent of motive power of the Grand Trunk Pacific at Transcona, Man., succeeding G. W. Robb, resigned.

R. C. Earlywine has been appointed assistant air brake instructor of the second and third districts of the Chicago, Rock Island & Pacific at El Reno, Okla.

J. E. Epler, assistant to the general manager of the Chicago & Eastern Illinois, has been appointed superintendent of motive power, with headquarters at Danville, Ill., to succeed J. H. Tinker, resigned, and the former office is abolished.

W. S. Moseley has been appointed mechanical engineer of the Carolina, Clinchfield & Ohio, with headquarters at Erwin, Tenn. He was born on March 5, 1880, at Bonsack, Va., and was educated in the public schools and at Virginia Polytechnic Institute, Blacksburg, Va. He began railway work as a messenger boy in the auditor's office of the Norfolk & Western, and from June, 1894, to January, 1899, was messenger and clerk in the same office. He was then for three years machinist apprentice in the Norfolk & Western shops and drawing office at Roanoke, Va., and from January, 1902, to January, 1909, was draftsman in the mechanical engineer's office of the same road, with the exception of two years, during which time he was an assistant shop instructor and special student at the Virginia Polytechnic Institute. In January, 1909, he was appointed mechanical draftsman of the Carolina, Clinchfield & Ohio, which position he held at the time of his recent appointment as mechanical engineer of the same road as above noted.

H. E. Reynolds has been appointed assistant air brake instructor of the first district of the Chicago, Rock Island & Pacific at Des Moines, Ia.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

William O'Brien has been appointed master mechanic of the Springfield division of the Illinois Central at Clinton, Ill., succeeding Fred M. Baumgardner, resigned to accept a position with the Interstate Commerce Commission, division of valuation.

W. D. Deveny has been appointed division master mechanic of the Arkansas River and Colorado divisions of the Atchison, Topeka & Santa Fe at La Junta, Colo., succeeding Hugh Gallagher.

G. Glasford has been appointed district master mechanic of the Canadian Pacific at Cranbrook, B. C.

T. C. Hudson has been appointed master mechanic of the Quebec Grand division of the Canadian Northern at Joliette, Que.

A. J. Ironsides has been appointed district master mechanic of the Canadian Pacific at Edmonton, Alta.

John Kerr has been appointed road foreman of engines of the Canadian Northern at Joliette, Que.

T. R. McLeod has been appointed master mechanic of the Ontario Grand division of the Canadian Northern, Eastern lines, at Toronto, Ont.

T. S. Lowe has been appointed master mechanic of the Lake St. John division of the Canadian Northern at Limoilou, Que.

W. C. Moore has been appointed road foreman of engines of the Ottawa division of the Canadian Northern, Eastern lines, at Trenton, Ont.

John A. Marshall has been appointed road foreman of engines of the Northern Pacific, at Duluth, Minn.

W. J. Rennix, district master mechanic of the Canadian Pacific at Cranbrook, B. C., has been transferred in that capacity to Calgary, Alta.

G. F. Shull has been appointed acting master mechanic of the Carolina, Clinchfield & Ohio at Erwin, Tenn., succeeding H. F. Staley, master mechanic, resigned.

CAR DEPARTMENT

J. Hodgson has been appointed foreman, car department, of the Quebec division of the Canadian Northern at Joliette, Que.

F. Gouge has been appointed foreman, car department of the Lake St. John division of the Canadian Northern at Limoilou, Que.

H. J. White has been appointed general foreman, car department, of the Quebec Grand division of the Canadian Northern at Joliette, Que.

SHOP AND ENGINE HOUSE

Otto Braun has been appointed assistant foreman of the Pittsburgh & Lake Erie at McKees Rocks, Pa.

F. E. Cooper has been appointed machine shop foreman of the

Pittsburgh & Lake Erie at McKees Rocks, Pa., succeeding J. R. Radcliffe, resigned.

J. W. Findlay has been appointed general foreman of the Canadian Northern at Parry Sound, Ont.

Joseph Fritts has been appointed foreman of the Atchison, Topeka & Santa Fe at Syracuse, Kan., succeeding P. Ragan.

R. H. Hall has been appointed locomotive foreman of the Grand Trunk Pacific at Regina, Sask.

R. A. Miller has been appointed general foreman of the Ottawa division of the Canadian Northern, Eastern lines, at Trenton, Ont.

PURCHASING AND STOREKEEPING

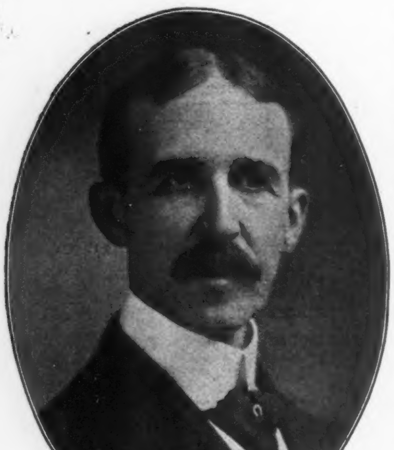
F. B. Calhoun has been appointed storekeeper of the Pecos division of the Atchison, Topeka & Santa Fe at Vaughn, N. M.

LeRoy Cooley has been appointed general storekeeper of the Central Railroad of New Jersey at Elizabethport, N. J., succeeding C. B. Williams, promoted. Mr. Cooley was born July 19, 1877, at Flemington, N. J., and began railway work in 1899, as a clerk in the office of the superintendent of motive power of the Central Railroad of New Jersey, and has been in the continuous service of that road ever since. He held various positions until September, 1908, when he was appointed chief clerk in the same office.

W. A. Dickinson has been appointed traveling storekeeper of the Atchison, Topeka & Santa Fe at Topeka, Kan.

G. J. Fleisch has been appointed general traveling storekeeper of the Atchison, Topeka & Santa Fe at Topeka, Kan.

W. G. Phelps, who has been appointed purchasing agent of the Pennsylvania Lines West of Pittsburgh, with headquarters at Pittsburgh, Pa., was born at La Porte, Ind., and was educated in the public and private schools of his native town and of Valparaiso. From 1877 to 1884, Mr. Phelps was telegraph operator and agent on the Vandalia Railroad, and then left the service of that company. On November 5, 1888, he returned to the service of the Vandalia as a clerk in the general freight office at St. Louis, Mo. He was appointed chief clerk to the fourth vice-president of the Pennsylvania Lines West of Pittsburgh on June 9, 1901, and was promoted to assistant purchasing agent on January 1 1913, with headquarters at Pittsburgh, which position he held at the time of his appointment as purchasing agent of the same road, as above noted.


W. G. Phelps

Earl Preston has been appointed storekeeper of the Panhandle division of the Atchison, Topeka & Santa Fe at Waynoka, Okla.

N. R. Snowden has been appointed storekeeper of the Albuquerque division of the Atchison, Topeka & Santa Fe at Belen, N. M.

L. C. Thomson, storekeeper of the Canadian Northern Ontario, at Toronto, Ont., has been appointed division storekeeper of the Ontario Grand division of the Canadian Northern, Eastern lines, at Toronto, Ont.

George E. Scott, whose appointment as purchasing agent of the Missouri, Kansas & Texas, at St. Louis, Mo., was announced in the August issue, was born May 27, 1885, at Cleveland, Ohio. He received a grammar school education, and began railway work with the Lake Shore & Michigan Southern in July, 1901, as telegraph messenger at Toledo, Ohio. Subsequently he was clerk to the assistant superintendent and superintendent, and from December, 1905, to January, 1907, was secretary to the general superintendent and assistant general manager of that road at Cleveland. He was then until July, 1911, secretary to the vice-president of the New York Central Lines at Chicago, being made assistant chief clerk to the vice-president on the latter date. In May, 1912, Mr. Scott went to the Missouri, Kansas & Texas, as secretary to the president, and one year later was made assistant purchasing agent. On January 1 of this year he became acting purchasing agent, and on July 1 was appointed purchasing agent, as above noted.


Photo by Matzene, Chicago.
G. E. Scott

C. B. Williams, general storekeeper of the Central Railroad of New Jersey at Elizabethport, N. J., has been appointed purchasing agent with office at New York City.

OBITUARY

Charles R. Frazer, formerly engine inspector of the Missouri Pacific at St. Louis, Mo., died on August 17 at the age of 66.

Darius Miller, president of the Chicago, Burlington & Quincy and of the Colorado & Southern, died at Glacier Park, Mont., on August 23, after an operation for appendicitis.

Morris Davis, formerly foreman boiler maker for the Pennsylvania Railroad, died at Altoona, Pa., August 15, at the age of 72. He was employed by the Pennsylvania for almost 50 years and retired on a pension five years ago.

Jacob C. Miller, formerly master mechanic of the Eastern district of the Chicago, Milwaukee & St. Paul, died suddenly on July 25, at his summer camp on Tomahawk Lake, Minocqua, Wis., from apoplexy, aged 61 years. He retired from active railway service February 1, 1910, since which time he had been living at Maywood, Ill.

Robert Moran, master mechanic of the Louisville & Nashville, with office at Nashville, Tenn., was drowned while bathing at Santa Rosa Island, Fla., on July 31. He was born on February 10, 1857, at Wilmington, Del., and began railway work in November, 1870, as an apprentice in the machine shops of the Edgefield & Kentucky, at Edgefield, Tenn., and since that time he has been in the continuous service of its successor, the Louisville & Nashville and lines now forming part of that road. In December, 1890, he was appointed master mechanic at Bowling Green, Ky., and since February, 1900, was master mechanic at Nashville, Tenn.

John Player, formerly superintendent of machinery of the Atchison, Topeka & Santa Fe, died at Chicago on August 14

aged 67 years. Mr. Player began railway work in June, 1873, and until September, 1887, was with the Central Iowa consecutively as machinist, general foreman of shops, master mechanic and also in charge of the car department. He then became superintendent of motive power of the Wisconsin Central, leaving that road in June, 1890, to go to the Atchison, Topeka & Santa Fe as superintendent of machinery, which position he held until January, 1902, when he was appointed consulting superintendent of motive power. In June of that year he retired from active railway service on account of ill health.

WILLIAM BARSTOW STRONG, who from 1880 to 1889 was president of the Atchison, Topeka & Santa Fe, died at Los Angeles, Cal., on August 3. He was born at Brownington, Orleans county, Vt., on May 16, 1837, and graduated from Bell's Business College, Chicago, in 1855. He began railway work as station agent and telegraph operator in March of the same year at Milton, Wis., and was later station agent at White Water and at Monroe, and then general western agent of the Southwestern division of the Chicago, Milwaukee & St. Paul at Janesville, Wis. From 1865 to 1867, he was assistant superintendent of the McGregor & Western, now a part of the Chicago, Milwaukee & St. Paul. He was then to 1870 general western agent of the Chicago & North Western, and from 1870 to 1872 was assistant general superintendent of the Chicago, Burlington & Quincy at Burlington, Iowa. In 1872 he was appointed assistant general superintendent of the consolidated Burlington & Missouri River and the Chicago, Burlington & Quincy at Chicago, and in 1874 became general superintendent of the Michigan Central at Chicago. The following year he was appointed general superintendent of the C. B. & Q., and from 1877 to 1880 was vice-president and general manager of the Atchison, Topeka & Santa Fe at Topeka, Kan. He was then president of the same road, with headquarters at Boston, Mass., until 1889, at which time he retired from active service.

NEW SHOPS

ATCHISON, TOPEKA & SANTA FE.—A contract has been awarded for the building of a new reinforced concrete engine house at Albuquerque, N. M., to Henry Bennett & Sons, Topeka, Kan. The estimated cost is $100,000. Plans are also being made for additional improvements at this point.

ILLINOIS CENTRAL.—This company recently started work on the construction of a small mechanical terminal at Dyersburg, Tenn., together with a yard at that place. The total cost of the improvements will be about $100,000. The buildings will consist of a four-stall roundhouse and boiler house, together with an 85-ft. turntable equipped with electric tractor, all buildings to be of frame construction. The railroad company is doing the grading and track laying, and the construction of the buildings will be let by contract.

NORFOLK SOUTHERN.—The Biscoe, N. C., shops of this company have been discontinued and all the machinery has been removed to the company's Glenwood yard shops at Raleigh, N. C. It is not proposed, however, to erect large shops at this point. The company has constructed a six stall engine house, equipped with drop pits, and connected with a new machine shop, 40 by 90 ft. in size, a woodworking shop 30 ft. by 50 ft., an oil house and small storehouse and a 300-ton coaling station and an ash pit. The total expenditure has not exceeded $30,000.

PEAT IN THE FALKLAND ISLANDS.—No less than one-sixth of the total area of the Falkland Islands, which embrace territory amounting to about 6,500 square miles, is entirely composed of peat, having a calorific value and richness which compare favorably with the best peat that is produced.—*Engineering*.

SUPPLY TRADE NOTES

Graham Dedge, assistant sales manager of the Edgar Steel Seal & Manufacturing Company, Chicago, has been appointed assistant general manager, in addition to his present duties.

C. W. Rhoades has been appointed manager of sales of the Daniels Safety Device Company, manufacturer of the "Bulldog" nut, with office in the Webster building, 327 South La Salle street, Chicago. Mr. Rhoades was formerly assistant sales manager of Valentine & Company, and previously was with the St. Louis Surfacer Company.

Wishing to enlarge the market for the products of their clients, W. L. Rickard, of Rickard & Sloan, Inc., New York, will make an extended trip through South America, leaving New York the latter part of September. He will visit the principal cities on both coasts and will make a thorough investigation of the markets and the best method of selling machinery and mechanical materials and devices.

Willard Doud, formerly shop engineer of the Illinois Central and Chicago, Burlington & Quincy, having completed the special engineering work involved in the construction of the new shops for the Belt Railway of Chicago, at Chicago, announces the opening of offices in the Morton building, 538 South Dearborn street, Chicago, for the handling of all matters pertaining to the design, construction, equipment and operation of railroad and industrial shops and power plants.

Judge Killitts of the United States District Court of the Northern District of Ohio, Western division, on August 15, handed down a decision finding that the Baker valve gear patents Nos. 721, 994 and 1,008,405 of the Pilliod Company are valid, and that the Pilliod Brothers Company and Charles J. Pilliod in the manufacture and sale of their so-called B valve gear infringe claim 8 of patent No. 721,994 and claims 1 and 2 of patent 1,008,405. Both defendants are estopped from denying the validity of the latter patent.

Thomas A. Griffin, chairman of the board of directors of the Griffin Wheel Company, Chicago, died on the steamship Korea on the way from Yokohama to Honolulu on August 12. Mr. Griffin was born August 28, 1852, at Rochester, N. Y. His first business experience was as an apprentice at Rochester, and since 1868 he had been continuously in the car wheel manufacturing business. In 1875 he went to Detroit and operated for the Michigan Car Company its plant known as the Detroit Car Wheel Company. In 1879 the Griffin Car Wheel Company of Detroit was organized, and the following year Mr. Griffin went to Chicago, where he organized the Griffin & Wells Foundry Company, which was merged into the Griffin Wheel & Foundry Company in 1886. Mr. Griffin at this time acquired all of the interest in the Griffin Car Wheel Company at Detroit, and subsequently the name of this company was changed to the Griffin Wheel Company. Besides having five foundries in Chicago the company operates foundries in Boston, St. Paul, Detroit, Kansas City, Denver, Tacoma and Los Angeles.

T. A. Griffin

CATALOGS

TELEPHONE CORDS.—This is the title of a booklet issued by the Western Electric Company, Chicago. It takes up in considerable detail cords used for different classes of telephone service.

IRON ROOFS.—A booklet issued by the American Rolling Mill Company, Middletown, Ohio, deals with the subject of iron roofs that resist rust. A number of illustrations are included showing the types of roofing made from Armco iron.

SHEET METAL.—The Stark Rolling Mill Company, Canton, Ohio, manufacturer of Toncan metal, has recently issued a booklet dealing with the advantages claimed for this material. A number of illustrations are included showing its application.

DEFEATING RUST.—This is the title of a booklet issued by the American Rolling Mill Company, Middletown, Ohio, which gives the story of Armco iron. The booklet contains some historical matter and describes the different uses for this class of iron.

BOLT CUTTERS.—A leaflet recently issued by the National Machinery Company, Tiffin, Ohio, deals with accuracy in the cutting of threads. The leaflet includes illustrations of a taper blank before threading, and the same blank after being threaded by a National die head.

TWIST DRILLS.—A leaflet issued by the Whitman & Barnes Manufacturing Company, Akron, Ohio, considers the advantages of the high speed twist drills manufactured by that company. A number of these drills were used in the construction of the locks on the Panama Canal.

FUEL OIL ENGINES.—Bulletin No. 34-W from the Chicago Pneumatic Tool Company, Chicago, is devoted to the Giant low grade fuel oil engines. The bulletin describes and illustrates the details of construction and gives a list of the sizes and capacities in which the engine is made.

WATER GAGES.—A pamphlet from the Prince-Groff Company, 50 Church street, New York, describes the Pressurlokd water gage. As the name indicates, the glass is sealed by the water pressure and the gage is so arranged that in case of a broken glass the fractures are kept closed.

SPRAYERS AND WHITEWASHERS.—Catalog No. 176 from the Dayton Manufacturing Company, Dayton, Ohio, describes the Dayton sprayers and whitewashers. These sprayers are adaptable to a number of uses, including the application of whitewash, water paints and other wall coatings.

PIPE WRENCHES.—The Prince-Groff Company, 50 Church street, New York, has issued a leaflet devoted to the Kwikgrip pipe wrench. The advantage claimed for this wrench lies in the construction of the jaws, the jaw containing the teeth being placed parallel with the center line of the handle.

PORTABLE FLOOR CRANES.—The Canton Foundry & Machine Company, Canton, Ohio, has sent out a booklet describing the portable floor crane and hoist manufactured by that company. These cranes are made in a number of sizes and are so arranged that they can be readily moved by hand from place to place about a shop.

AIR COMPRESSOR VALVES.—Bulletin No. 3024, issued by the Ingersoll-Rand Company, 11 Broadway, New York, is devoted to the discussion of the Ingersoll-Rogler valves for air compressing cylinders. This bulletin takes up this type of valve in more detail than bulletin No. 3030, which deals with the complete air compressor.

MAGNETO TELEPHONES.—Magneto telephones and supplies is the subject of a 40-page catalog issued by the Western Electric Company, Chicago. The catalog lists only such standard telephone apparatus and supplies as are generally used by a telephone company using magneto equipment and having about 200 telephones or less.

BALL BEARINGS IN MACHINE TOOLS.—This is the subject of a catalog issued recently by the Hess-Bright Manufacturing Company, Philadelphia, Pa. It contains a brief history of early ball bearings, and after devoting some space to the origin of the annular type takes up the application of ball bearings to different classes of machine tools.

CONVEYOR SCALES.—The Electric Weighing Company, New York, has issued bulletin No. 8 which deals with the conveyor scales manufactured by this company for use with various types of belt and bucket conveyors. A number of electric specialties are also briefly described, including a recording counter and an ampere hour meter. The leaflet contains 18 pages and has a number of illustrations.

PIPE THREADING MACHINE.—A booklet entitled Actual Pipe Threading Experiences II has been received from the Oster Manufacturing Company, East Sixty-first street, Cleveland, Ohio. This booklet deals largely with the experience of a number of users of Oster pipe threading machines. It also contains several illustrations and a short description of the practices followed in the manufacture of these machines.

AIR COMPRESSORS.—Bulletin No. 3030 from the Ingersoll-Rand Company, 11 Broadway, New York, describes the Ingersoll-Rogler, class ER-1, power driven, single phase, straight line air compressor. The distinguishing feature of this compressor is the type of air valve which is considered at some length in the pamphlet. Illustrations are included showing the construction of the valve as well as different parts of the compressor.

VALVELESS ENGINES.—From stone cold to full power in 10 seconds is the subject of an illustrated catalog issued by the Harris Patents Company, Philadelphia, Pa., and describing the Harris valveless engine which is constructed on the Diesel principle. Among the drawings included are those for a locomotive equipped with a 320 indicated h. p. Harris valveless engine. The Harris high and low pressure air compressor is also described.

PUMPING MACHINERY.—Bulletins 10 and 11 from the National Transit Company, Oil City, Pa., are devoted to pumping machinery. These bulletins are issued with a view to making a flexible catalog bound in loose leaf covers. Bulletin No. 10 gives directions for setting up an operating pump, and also deals with duplex piston pumps and vertical triplex power pumps. Bulletin No. 11 is devoted to different sizes of duplex piston pumps and includes a list of parts.

THE YOUNG MAN AND THE ELECTRICAL INDUSTRY.—This is the title of special publication No. 1542 recently issued by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa. It is a reprint of an article by James H. Collins which appeared in the Scientific American, May 16, 1914. It deals in an interesting way with the opportunities afforded a young man in this industry and the different lines in which he may direct his activities, as exemplified by the works of the Westinghouse company. A copy of the booklet will be sent on request to any one interested in the development of young men.

RELATIVE CORROSION OF IRON AND STEEL PIPE.—National bulletin No. 10-C from the National Tube Company, Pittsburgh, Pa., contains an illustrated article giving the results of an investigation into the relative rust of iron and steel pipes which have been in continuous service for a considerable number of years. This investigation was conducted by William H. Walker, Ph.D., professor of industrial chemistry and director of the research laboratory of applied chemistry, Massachusetts Institute of Technology, Boston; the article is an abstract of a paper read before the New England Water Works Association. In addition, the bulletin contains three other articles on the subject of corrosion.